ACCULTURATION IN THE UPPER MIDDLE MISSOURI VALLEY
AS REFLECTED IN MODIFIED BONE ASSEMBLAGES

by

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ABSTRACT

During the process of contact, the Plains Village peoples of the Upper Middle Missouri Valley were exposed to repeated smallpox epidemics and the introduction of Euro-American technology. This dissertation traces the resulting process of acculturation through analysis of changes in bone tool assemblages from three carefully tested Hidatsa earthlodge villages at the mouth of the Knife River in central North Dakota.

Test excavations were carried out at Lower Hidatsa (32ME10), Sakakawea (32ME11), and Big Hidatsa (32ME12) villages, all of which were occupied by subgroups of the Hidatsa prior to and during the period of Euro-American contact. A total of 894 bone tools were recovered from the three sites. They were classified according to the established bone tool typology for the Middle Missouri and coded for computer-assisted manipulation.

The bone tools were tabulated with reference to provenience, component, and a series of tool-specific variables in order to ascertain the assemblage structure for each site. The assemblages from all three sites were then combined into one continuous sequence from A.D. 1400-1845 so that changes could be observed throughout the process of contact with reference to the Indirect, Middlemen, and Direct periods of the fur trade.

The Indirect trade period began by A.D. 1600, with observable changes in the bone tool assemblage as metal tools reached the villages through other Indian groups. Small frequencies of bone tools modified with metal are present, and small piercing tools or awls are very low in frequency. By the end of the Indirect trade period in A.D. 1750, knife handles with metal slots are present, and increases in scapula tools and expedient tools can be documented. On the basis of these changes, substantial social disruptions are postulated prior to actual contact with Euro-Americans. During the Middlemen and Direct trade periods, increases in scapula tools, expedient tools, and bone tools modified with metal can be documented as the Hidatsa achieved maximum involvement in the fur trade. It is proposed that these changes reflect continuing social disruption and an increasing level of dependence upon the traders.

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INTRODUCTION

The following research investigates acculturation in the upper Middle Missouri valley of the northern Plains as reflected in modified bone assemblages. The assemblages are from three late Protohistoric-early Historic Plains Village Tradition earthlodge villages in the upper Knife-Heart Region of central North Dakota (Lehmer 1971:29). The Knife-Heart Region is unique in the Middle Missouri in that it is essentially intact, in contrast to other regions both upstream and downstream which have been largely inundated by construction of enormous reservoirs on the main stem of the Missouri. The lower portion of the Knife-Heart Region has not been flooded, but has nevertheless been heavily disturbed by urban expansion near the cities of Bismarck and Mandan. The upper Knife-Heart region is fairly remote and has largely been spared major disturbance, despite recent large-scale coal mining and power generation.

The modified bone assemblages analyzed in this study were gathered during the course of research at the Knife River Indian Villages National Historic Site (KNRI) located just north of the town of Stanton, North Dakota at the mouth of the Knife River (Fig. 1). The park was created by an act of Congress in 1974 in order to preserve significant archaeological resources in the last intact segment of the Middle Missouri. Beginning in 1976, the National Park Service and the University of North Dakota conducted a long-term archaeological research program in the park. Its goals were to

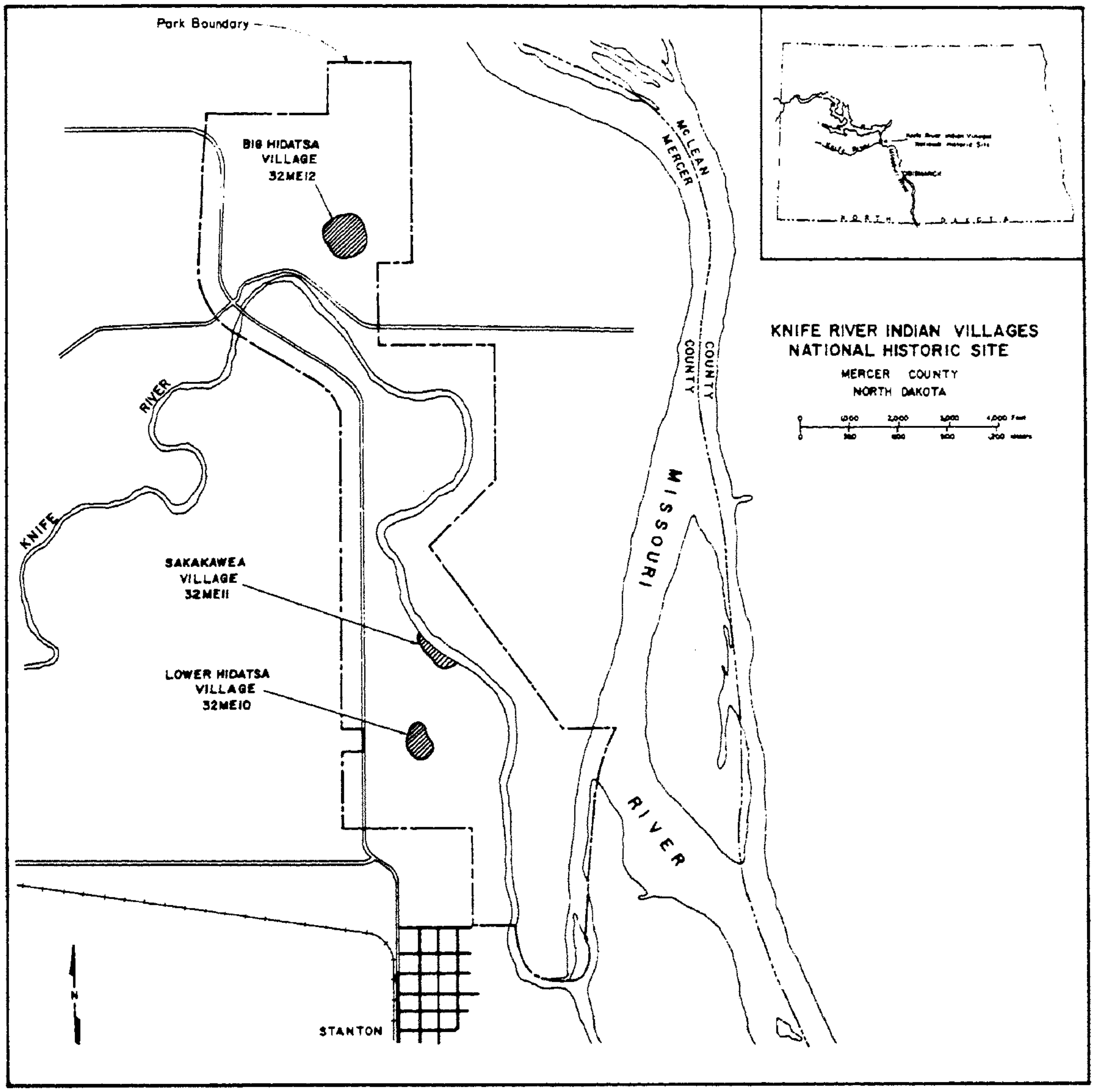


Figure 1. Map of the Knife River Indian Villages National Historic Site (KNRI) showing the location of the three major earthlodge villages examined in this study (Ahler et al. 1980:3).

make a detailed contribution to the understanding of regional prehistory, and to provide the basis for National Park Service interpretive programs. The work was guided by a comprehensive research design developed by the project director, Dr. Stanley A. Ahler of the University of North Dakota (Ahler 1978). The author's involvement with this project provides the basis for the following research.

Ecological Setting and Resources

The upper Knife-Heart Region is located within the rigorous environment of the Northern Plains, which shaped the aboriginal occupation of the area (Lehmer 1971:49-55; Lovick and Ahler 1982:42-45). Winters are typically long and cold, with subzero temperatures much of the time. The wind blows almost constantly, whipping the light snow cover into blinding flurries. The summers, in their own way, are no less rigorous. Extreme heat is common, often combined with a steady, hot wind. The average precipitation in the vicinity of the KNRI is 16.13 inches, with most falling in the spring and early summer. With an average growing season of 115 days, the KNRI is near the northern margin of effective aboriginal horticulture. These marginal conditions dictated a hunting and gathering subsistence pattern for most of the native groups in the area.

In this environment, the Middle Missouri valley is a unique oasis, a linear extension of the Eastern Woodlands. Within the valley, the environment is strikingly different from the surrounding prairies. In its undisturbed state, the flood plain is forested, allowing a refuge from the winds in both winter and summer. Before dam construction, the river flooded annually and enriched the soft, easily worked soil of the flood plain. Unlike the dry uplands with their dense, tough prairie sod, the Missouri flood plain soils could be successfully worked with simple hand tools. The valley and surrounding prairies also supported a wide variety of faunal resources, the most important of which was the bison. In addition, numerous species of smaller mammals and fish were also available. These factors combined to provide the basis for substantial, long-term sedentary occupation of the valley by peoples of the Plains Village Tradition. They lived in substantial earth and timber dwellings grouped together in villages. Subsistence was a combination of bison hunting and gardening on the floodplain of the Missouri where they grew hardy varieties of corn, beans, and squash. The three river tribes, Mandan, Hidatsa, and Arikara were the historic expression of the Plains Village Tradition.

Physiographic Zones

The Middle Missouri valley contains four broad, fairly distinct physiographic zones (Lehmer 1971:50-53). The first is the forested flood plain, located immediately above the river. Prior to dam construction, annual flood waters deposited a layer of silt, enriching the soil and making the flood plain the preferred location for aboriginal gardens. Today, much of this zone is under cultivation but in undisturbed areas, it is forested. The forest is composed of a wide variety of overstory and understory species, the composition of which varies according to the degree of succession. Burgess et al. (1973:5-8) and Griffin (1977) provide detailed discussions of flood plain forest succession in the vicinity of the study area.

The second zone is an area of discontinuous, level or gently sloping terraces representing previous flood plain levels of the Missouri River. Where not disturbed by modern cultivation, they are covered with prairie grasses. They are believed to be mid-Holocene to Mid-Pleistocene in age and are usually separated from the flood plain by a distinct scarp, as is the case within the KNRI. The terraces are beyond the reach of annual floods, and yet are close to the resources of the river and flood plain. For these reasons, virtually all earthlodge villages are located in this zone.

The third physiographic zone is known as the breaks, and consists of the eroded valley wall above the terrace zone. The breaks are highly dissected and very rugged in most areas, as is the case near the KNRI. Water sources in the form of small springs or seeps are relatively common, and near the KNRI, these are often surrounded by the remains of substantial prehistoric occupation. The steep slopes of the breaks are covered with prairie grasses, but the sheltered draws are wooded, especially in the vicinity of water sources.

The fourth and highest zone is the uplands, which begins above the breaks. In the vicinity of the KNRI, the transition from the breaks to the uplands is fairly abrupt, with the uplands being characterized by level to gently rolling prairie. Wooded areas are quite rare in the uplands, being confined entirely to sheltered areas such as creek bottoms.

All four of these zones are present in the vicinity of the KNRI, but within the park boundaries, only two, the flood plain and the terraces are present. The park contains a total of five Pleistocene age and three Holocene age terraces in the area immediately surrounding the confluence of the Knife and Missouri Rivers. A detailed discussion of the soils, geology, and terrace structure of the KNRI can be found in Reiten (1983).

Sites Investigated

Modified bone assemblages from the three large earthlodge villages within the KNRI have been examined for this study. Based upon historic records, it can be determined that all three sites were occupied by distinct subgroups of the Hidatsa tribe. They are Lower Hidatsa (32ME10), Sakakawea (32ME11), and Big Hidatsa (32ME12). All three of these sites are quite large and have seen numerous archaeological investigations in the years since Euro-American settlement of the area. These investigations varied widely in scope and quality and will be summarized in a later section.

The Lower Hidatsa site contains 51 circular earthlodge depressions and is located in the central portion of the KNRI (Fig. 1). It was occupied by the Awatixa subgroup of the Hidatsa from about 1450 until its abandonment in 1780. It was abandoned prior to the arrival of Euro-American explorers and traders so their journals record Awatixa occupation in the Sakakawea and Big Hidatsa villages.

The Sakakawea site contains 31 circular house depressions and is located in the central portion of the KNRI, on the right bank of the Knife River. It was also occupied by the Awatixa subgroup of the Hidatsa from about 1798 until 1834/37. The village gets its name from Sakakawea, a Shoshone woman who lived in the village and served as guide for the Lewis and Clark expedition during their journey to the Pacific coast. The site is adjacent to the Knife River and has been partially destroyed by cutbank erosion, but recent construction of an erosion-resistant berm beneath the cutbank has ensured its continued preservation.

The Big Hidatsa site is the largest of the three villages, with 113 circular house depressions. It is located in the northern portion of the KNRI and was occupied by the Hidatsa-Proper subgroup of the Hidatsa from about 1600 until 1837 when the river tribes were decimated by a major smallpox epidemic (Fig. 1). It was then occupied by remnants of the Hidatsa and Mandan from 1837 until 1845 when they moved to Like-A-Fishhook village near the lower end of what was to become the Fort Berthold Reservation.

Problem Statement

The three villages, Lower Hidatsa, Sakakawea, and Big Hidatsa span the period of Euro-American contact in the upper Knife-Heart region. They were located at the point of contact between established native cultures and the expansionist Euro-American culture of the 18th and 19th centuries. Prior to contact, the villagers were already involved in a wide ranging aboriginal trade network with established links stretching as far as the Pacific coast. Euro-American traders used these trade networks to involve the river tribes and their nomadic neighbors in the fur trade. For a time, the river tribes maintained a lucrative role as middlemen in the trade, but a series of smallpox epidemics reduced their numbers while the influx of Euro-American technology rapidly created a dependence on the traders. Some of the traders kept journals describing life in the villages, as did explorers who penetrated the area, the best known being the Lewis and Clark expedition of 1804-1806. These journals provide a level of detailed first hand observation seldom available to archaeologists. The three KNRI villages provide an excellent laboratory for the examination of rapid, well documented cultural change.

This study will focus on the modified bone industry from the three sites. Modified bone is a major aboriginal industry, present in abundance in the villages. The bone tool assemblage changes dramatically with the introduction of Euro-American metal tools. Prior to contact, a large diverse bone tool industry is present. After contact, the disappearance of certain tool types, such as small piercing tools, can be documented as they are replaced with metal substitutes. In addition, bone tools modified with metal can be observed, followed later in the stratigraphic sequence by the all but complete replacement of the bone tool industry with metal tools.

The purpose of this research is to examine cultural change from the perspective of one large native industry. A specific type of cultural change will be examined, that of acculturation. Acculturation is defined as those cultural changes resulting from continuous first-hand contact between individuals from two different cultures, resulting in cultural changes for either or both groups (Redfield et al. 1936:149-150). Most examples of acculturation documented in the literature are instances of contact between preindustrial native societies and expanding industrial societies, as was the case in the KNRI. This contact results in the mutual borrowing of items and ideas, primarily by the native group. The end result is usually the partial, or in some cases, complete disintegration of the native group. Acculturation has been well documented among living groups, but has seen minimal application in archaeological situations where documentation is more difficult. This study represents a unique opportunity to examine acculturation from an archaeological perspective.

This study has two specific goals. First is the construction of a model illustrating acculturation as reflected in the replacement of bone tools with metal substitutes, taking into account Euro-American penetration of the area and the associated smallpox epidemics. The second goal is to define the relationship between assemblage structure and level of acculturation. This information will be relevant to archaeology in areas where good historic documentation is not available.

In the following discussion, Chapter 2 will discuss regional culture history, with an emphasis upon Plains Village developments and Hidatsa tribal movements as reflected in oral histories. Chapter 3 will cover Euro-American contact and its implications while Chapter 4 will discuss the field and laboratory procedures employed to process the cultural materials. In Chapter 5, the development of bone tool analysis and classification procedures will be discussed. Chapter 6 will describe analysis procedures employed in this study, while the analysis results will be presented in Chapter 7. The study conclusions will be offered in Chapter 8.

REGIONAL CULTURE HISTORY

The study area is located in the northern portion of the Middle Missouri Valley of the northern Plains. Contrary to the beliefs of many travelers, the Plains are not a vast area of featureless grassland, but rather contain major topographic and climatic variability. Recognizing this variability as well as local differences in cultural developments, Wedel (1961:23) divided the Plains into five subareas. These are the Southern Plains, Central Plains, Northwestern Plains, Middle Missouri, and Northeastern Periphery. The KNRI is located in the northern portion of the Middle Missouri, between the Northwestern Plains and the Northeastern Periphery. The Northwestern Plains range from the Rocky Mountains on the west to the Missouri River on the east. The subarea contains great topographic variability, but is generally a semiarid, rugged place characterized by chains of mountains and intermontane basins (Frison 1978:1-8). The Northeastern Periphery is a much different area, consisting of the glaciated level to gently rolling landforms east of the Missouri River in what is now eastern North and South Dakota, and western Minnesota and Iowa. The prehistoric sequence in this area is poorly known even today, due to the general lack of large-scale archaeological research. Wedel's main (1961) interests were centered in the Central Plains, which may have led him to regard this area as peripheral. However, recent work in the Red River Valley of eastern North Dakota and western Minnesota suggests that the area saw heavy prehistoric use and served to join the northern Midwest Woodlands with the northern Plains. The term "Northeastern Plains" may, therefore, be more appropriate in a cultural-historical sense (Michlovic 1983).

The upper Middle Missouri Valley is located between these two subareas, and in many ways serves as a dividing line. Even the casual modern traveler can note sharp differences between the east and west sides of the Missouri River. On the east, the area is gently rolling and predominately farmland. On the west side, the area is more arid, with ranch land predominating. The buttes and other sharply eroded landforms of the Northwestern Plains are also visible. As will be discussed in later chapters, the inhabitants of the Missouri Valley used their location at this dividing point to their considerable advantage.

The Middle Missouri Subarea itself has been divided into six regions, in recognition of differences in cultural sequences and to aid in interpretation (Lehmer 1971:28-29). The study area is located within the Knife-Heart Region, which extends from just below the Heart River to just above the Knife River. The only upstream region is the Garrison, which extends to just above the mouth of the Yellowstone in Montana. The downstream regions are the Cannonball, Grand-Moreau, Bad-Cheyenne, and Big Bend, which ends just below the mouth of the White River in South Dakota.

Cultural Traditions

In the study area, the sequence of cultural development can be divided into four broad time periods, each of which is dominated by a single lifeway or cultural tradition. The four periods are Paleo-Indian (10,000 to 6000 B.C.), Archaic (6000 B.C. to A.D. 1), Woodland (A.D. 1 to 1000), and Plains Village (A.D. 1000 to 1861). These time periods were defined in their present form by Willey (1966), and modified for the Middle Missouri by Lehmer (1971). Specific information for the study area is drawn from Lovick and Ahler (1982).

The time periods were defined on the basis of many years of archaeological survey and excavation. The associated dates were derived primarily from Carbon-14 analysis. They do not represent abrupt beginning and ending points for the time periods or predominant lifeways that they contain. Climate is also a factor in the determination of time periods. It is not the main determinant, but it is a significant factor, especially early in the Paleo-Indian period where a cool, equable climate existed in the Plains as the result of continental glaciation. The characteristics of the time periods will be discussed below, along with a description of the development of modified bone technology in each.

Paleo-Indian (10,000 to 6000 B.C.)

The Paleo-Indian Period is a feature of the terminal North American Pleistocene, and is characterized by a big game hunting adaptation. The Plains were occupied by small, nomadic groups who hunted large fauna which has since become extinct. This adaptation was made possible through the cooler, more equable climate created by the presence of continental glaciation. The Paleo-Indian Period was defined on the Plains, and remains best known from sites in the area. It is divided into three complexes, Llano, Folsom, and Plano.

The Llano complex is restricted to a narrow time period, 10,000 to 9,000 B.C. The peoples in this complex subsisted in part by hunting mammoth, often attacking solitary animals which had become mired down in mud. At all of the sites, thin, well made lanceolate Clovis projectile points are found in association with the mammoth bones. Scrapers and other specialized tools are also found in association. The complex was originally defined at the Blackwater Draw site on the Llano Estacado (Sellards 1952). Llano sites containing remains of mammoth and Clovis projectile points include the Lubbock Lake site near Lubbock, Texas (Johnson 1983), the Lehner site in southeastern Arizona (Haury et al. 1959), and the Colby site in Wyoming (Frison 1978:85-112). The nature of the Llano remains and inference from modern elephant behavior would suggest that a common hunting strategy would be to separate an individual animal from its small group, wound it, and wait for it to falter so that it could be killed and butchered. There is no indication of large scale, communal hunting efforts during this time period.

The Folsom and Plano complexes are much more numerous across the Plains. They occur after 9,000 B.C., and all represent the remains of communal hunting of extinct forms of bison. The mammoths which were the main focus of the Llano complex had gone, apparently as the result of a warmer, drier climate. The bison were driven either into an enclosure, over a cliff, or into a ravine. The fall would have killed or disabled most of the animals, who then were easy prey for the hunters. The Folsom complex is named for the Folsom site in New Mexico where, in 1927, the remains of extinct Bison antiquus were found in undisputed association with fluted Folsom projectile points, marking a turning point in the study of North American prehistory.

The later Plano complex is characterized by beautifully flaked, unfluted lanceolate projectile points of a variety of styles. Some projectile point types include Agate Basin, Hell Gap, Plainview, Scottsbluff, and Eden. Some of the best known sites of the Folsom and Plano complexes include Olsen-Chubbuck (Wheat 1972), Lubbock Lake (Johnson and Holliday 1981), and Casper (Frison 1974). Communal bison hunting implies a high level of community cooperation and organization, in contrast to the more solitary hunting practiced by peoples of the Llano complex.

The Paleo-Indian period is perhaps best known for its lithic industry, especially the large, finely crafted projectile points. These points are often found among the bones of bison in kill sites, where they presumably functioned as spear points to dispatch the animals. Until fairly recently, it was assumed that bone tools did not play a significant role in Paleo-Indian life. However, recent analyses of bone from bison kills have revealed simple bone butchering tools fashioned from the long bones of the animals being butchered. These simple tools were apparently used as butchering aids to chop away muscle attachments and have been defined as "bone expediency tools" (Frison 1974; Johnson 1982). In addition to these, a small number of long slender bone projectile points have been found in association with Folsom sites (Frison and Ziemens 1980) and bone foreshafts designed to hold lanceolate projectile points have been found with a Clovis burial in Montana (Lahren and Bonnichsen 1974). This pattern of bone tools utilized as simple butchering implements as well as killing tools was established in the Paleo-Indian period and continued with very little modification into later periods.

Evidence of Paleo-Indian occupation in the Middle Missouri subarea is generally restricted to the lowest levels of deeply stratified sites which have been exposed by reservoir shoreline erosion. One example is the Walth Bay site near Mobridge, South Dakota where Paleo-Indian projectile points were found in situ in the lowest levels (Ahler et al. 1974). Another is the Moe site, on the shoreline of Garrison Reservoir where Paleo-Indian projectile points have been found on the beach below the site deposits. These artifacts, as well as blades found in situ suggest a Paleo-Indian origin (Schneider 1982). A unique exception to this pattern is the single component, late Paleo-Indian Travis 2 site near Mobridge, South Dakota (Ahler et al. 1977). It has not been cross-sectioned by shoreline erosion, but it has been scoured down each year as the waves have swept over it, leaving a portion intact. There is as yet no direct evidence of Paleo-Indian occupation in the KNRI, despite attempts to locate such occupations by extending test excavation units beneath Plains Village deposits.

Archaic (6,000 B.C. to A.D. 1)

The Archaic Period marks the beginning of a different adaptive pattern across the Plains. This is especially evident in the tall grass prairies of the eastern Plains which grade into the Midwest. Here, the climate was more moist than the western Plains, allowing human groups to pursue a broad-based pattern of exploitation emphasizing deer hunting, fishing, and gathering of nuts and seeds (Schmits 1978; Johnson and Wood 1980:38; Funk 1978). In the semi-arid short grass areas of the western Plains, the adaptive pattern was somewhat different. A base of foraging was maintained, along with a strong emphasis on communal bison hunting, a pattern carried over from the preceding Paleo-Indian Period (Frison 1978).

In the Middle Missouri, as in the surrounding subareas, the Archaic is characterized by the presence of a variety of lanceolate, side-notched and corner-notched projectile points. Archaic sites have seen little research in the Middle Missouri, but the available data indicate an emphasis on small game hunting and plant food gathering along with greater use of locally available lithic raw materials than was the case in the preceding Paleo-Indian Period (Lovick and Ahler 1982:52). The only site near the KNRI which has seen intensive investigation of Archaic components is the Mondrian Tree site on the Missouri River just below the mouth of the Yellowstone in McKenzie County, North Dakota (Toom and Gregg 1983). A few artifacts from this period have been found in the KNRI, but they were recovered in Plains Village contexts, where it is assumed that they were collected and re-used by the village peoples. If there are intact Archaic sites within the KNRI, they are deeply buried.

The bone tools of the Archaic Period reflect the subsistence patterns of the areas in which they were found. On the western Plains, many Archaic sites are bison kills which contain bone expediency tools. The same pattern of modified bone technology was continued from the preceding Paleo-Indian Period, with the exception of awls and humerus fleshers, common tools introduced during the Archaic which continued on into subsequent periods. The bone tools were being used in a hunting and foraging lifeway not sufficiently different from the Paleo-Indian Period to show any differences in the modified bone assemblages. In the eastern Plains and Midwest, the exploitation of a more diverse environment led to the introduction of a variety of new bone tools. By the middle Archaic, bone pins are present in Arnold Research and Graham caves in Missouri (Chapman 1975:159-183). In the late Archaic levels at the Koster site and at sites in Indiana, a more diverse assemblage including bone pins, pendants, flakers, fish hooks and awls is present (Tuck 1978:29-30). The compostion of modified bone assemblages is closely related to prevalent subsistence activities.

<u>Woodland (A.D. 1 to 1,000)</u>

The Woodland Period is marked by the inital appearance of distinctively styled pottery vessels, similar in appearance to those from Woodland sites in eastern North America (Wood and Johnson

1980:38). In the vicinity of the study area, most of this pottery is characteristically cord roughened on the exterior. The Plains Woodland represents the introduction of ceramics into the existing hunting and gathering groups without radically altering the lifeway established during the Archaic (Syms 1977). Sites from this period are generally restricted to the Middle Missouri Valley and the Northeastern Periphery where they have been locally defined as the Valley Complex (Syms 1977) and the Sonota Complex (Neuman 1975) respectively. Small burial mounds are associated with these sites in the Middle Missouri and the Northeastern Periphery and are referred to as the Devils Lake-Sourisford burial complex (Syms 1979). In the Northwestern Plains, the equivalent time period is referred to as the Late Prehistoric (Frison 1978).

The Woodland Period in the Midwest is much more extensive than that on the Plains. It is marked by the growth of agriculture, the construction of elaborate burial mounds, and the attainment of chiefdom-level social organization in some areas. Until fairly recently, information concerning the Plains Woodland was inferred from eastern North American, since ecologically, the Middle Missouri Valley represents a linear extension of the Eastern Woodlands into the Plains. This has not led to especially accurate interpretations regarding the Plains Woodland.

Recent research has provided data from which to describe the Woodland subsistence base and settlement pattern in the vicinity of the KNRI (Wood and Johnson 1973; Ahler et al. 1979; Ahler et al.

1981; Weston et al. 1980). From this research, it is believed that the Woodland Period can be divided into two parts, Early/Middle (A.D. 1 to 500), and Late (A.D. 500 to 1,000). The two periods are distinguished by the presence of dart or spear points in Early/Middle and by smaller arrowpoints in the Late period. This would suggest the introduction of the bow and arrow around A.D. 500. Although the Woodland Period began with human groups living much as they had during the Archaic Period, the later portion saw people living a more settled life in fairly permanent dwellings, and constructing numerous large conical and linear burial mounds overlooking the Missouri Valley. These mounds are much smaller than the enormous Woodland mounds of eastern North America. Both the conical and linear types are quite low, and difficult to locate on the ground, especially in areas which have been cultivated. They are, however, quite visible on aerial photographs.

There are numerous Woodland sites in the KNRI vicinity. The Stanton Mound Group is located just north of the KNRI boundary. It consists of a series of low conical and linear mounds on a fairly level terrace surface which is currently being mined for gravel. The High Butte mound (Chomko and Wood 1973) and a nearby occupation site (Wood and Johnson 1973) are located north of the Stanton mound group. Cultural resource survey and testing projects at two locations in the breaks south of the KNRI have revealed dense concentrations of Woodland sites. The first is the Glenharold coal strip mine immediately south of the KNRI (Ahler et al. 1979), while the second is the Cross Ranch, some 20 miles downstream from the

KNRI (Ahler et al. 1981). Both areas contain sites of varying functions, including campsites, linear mounds and bison kills, suggesting an intense occupation with many phases of activity.

Plains Woodland sites, including those in the KNRI vicinity, contain rather small modified bone assemblages which are quite similar to the earlier Archaic sites in the area. Bone expediency tools, fleshers and awls are the most common tools, but scapula hoes have been reported at Woodland sites in the Big Bend Region of the Middle Missouri (Hurt 1952:18-19).

No Woodland Period materials have been found in situ within the KNRI. Some isolated pre-Plains Village artifacts may date to this period, and there may be buried Woodland sites which were not detected in deep test excavations. The density of Woodland sites in the near vicinity suggests, however, that the KNRI area was intensively utilized during the Woodland Period.

Plains Village (A.D. 1,000 to 1861)

The Plains Village Tradition, or Plains Village Pattern (Lehmer 1971:27), represents the last, and most intensive native occupation of the Middle Missouri. The size and number of Plains Village sites has made them the main focus of research in the Middle Missouri. Much of this research was conducted in the form of salvage archaeology prior to impoundment of the enormous reservoirs which now cover most of the Missouri River in the Dakotas. The salvage effort was conducted under the auspices of the Smithsonian

Institution's River Basin Surveys, and continued from shortly after World War II until the late 1960's. The results of this research established the cultural sequence for the Middle Missouri and have been synthesized by Donald Lehmer (1971).

The Plains Village peoples established a settled, stable lifeway which endured for almost 900 years (Wood 1974). A balance was established with their cultural and natural environment. They may have been on the verge of greater cultural developments when their way of life was first modified, and then destroyed by Euro-American contact. The historic expression of the Plains Village Tradition consisted of the well known river tribes, the Mandan, Hidatsa, and Arikara.

Subsistence

The key to the stability of Plains Village culture lay in their mastery of horticulture. The village tribes cultivated hardy varieties of corn, beans, squash, and sunflowers on the flood plain of the Missouri. Their corn varieties were very well adapted to the rigorous environment of the northern Plains and were adopted by Euro-American settlers in the late 19th century. Plains Village corn varieties soon became the mainstay of local Euro-American agriculture (Will and Hyde 1917). The Plains Village peoples also depended heavily upon the bison, which could be obtained by hunting on the surrounding prairies, or by hauling floating carcasses out of the river during the spring breakup. But it was their dependable garden produce, and the knowledge of how to store it which made their settled, stable lifeway possible and gave them something of value to trade with their nomadic neighbors. All three village tribes utilized similar gardening techniques, but the most detailed descriptions of gardening were gathered from Buffalobird-woman, an elderly Hidatsa who was born in one of the Hidatsa villages at the mouth of the Knife River (Wilson 1917). The following description is drawn primarily from her recollections.

The fields for each village were always located on the Missouri River flood plain, where the soil was soft and easy to work. Fields were not located on the prairie uplands, since the soil was too hard and dry to be worked with hand tools. Each family had its own field, which was set off from others with simple markers. Since the flood plain was forested, the trees had to be cut down prior to planting. They were cut so they would fall over the intended field area and could be burned, which softened and enriched the soil. The preparation and tending of gardens fell to the women. After clearing, the soil was broken with wooden digging sticks, and then hoed with a bison scapula hoe hafted to a wooden handle. Scapula hoes had been replaced with iron hoes by the time of Gilbert Wilson's interviews with Buffalobird-woman, but in prehistoric sites, they are very common artifacts. After the field had been prepared, corn, beans, and squash were planted in hills, with the hills arranged in rough rows. Sunflowers were often planted around the outer margins of the fields. The fields were carefully cultivated during the growing season with scapula hoes as well as rakes made from wood or antler. The fields were watched from wooden stages to protect the crops from bird and animals.

Buffalobird-woman describes the harvest and crop preparation procedures in some detail (Wilson 1917:36-60). The corn was husked, braided and dried, and the best was saved for seed. After drying, the cobs were threshed to remove the kernels. Squash was harvested, sliced, and placed on spits to dry. The squashes were sliced with a prepared knife made from the thin portion of a bison scapula (Wison 1917:106). These are very distinctive and fairly common artifacts in Plains Village archaeological collections. Beans were harvested and dried as well.

Food storage was a critical aspect of Plains Village horticulture, so specialized means of storage and preservation were developed. Corn, beans, and squash were all stored in large, specially prepared subsurface cache pits (Wilson 1917:87-97). The pits were bell-shaped, and generally large enough for a person to climb into. They were dug by the women, and carefully prepared for use by lining with grass to protect the contents from moisture. The outer zone was filled with braided corn, while the central core was filled with loose corn and squash. When the pit was full, the neck was carefully sealed. The contents were generally usable all winter and into the next growing season. These pits are common in archaeological sites where they are found both inside and outside the houses. They are almost invariably filled with trash when found in archaeological sites, although one cache pit was found with its original contents at the White Buffalo Robe site, located immediately south of the KNRI (Lee 1980:119-121). The cache pits allowed long-term storage of garden produce for later consumption or trade.

Bone tools were an integral part of gardening (Wilson 1917:105-106). Scapula hoes served as the main cultivating implement, while deer antler rakes were used to help clear weeds. Squash knives, made from the thin portion of the bison scapula were used to slice squash, and presumably for other slicing tasks as well.

Housing

All three of the village tribes lived at least most of the year in substantial, earth and timber earthlodges. As will be discussed below, earthlodge form varied through time, but the basic construction techniques were quite similar. The most detailed descriptions of earthlodge construction were gathered by Gilbert Wilson (1934) from Hidatsa informants on the Fort Berthold Reservation, and they form the basis for the following description.

The building of a circular Hidatsa earthlodge was a community effort. Payment for assistance in earthlodge construction was made in the form of a feast given by the owner of the new lodge. Construction began with the raising of the four main supporting posts and the beams which rested upon them. The rights to supervise this process were held by a few women in the village. As was the case with other ceremonial powers, earthlodge construction rights had to be purchased. After the main posts had been set into prepared post holes, horizontal beams were laid across their tops, forming a cube. No pegs or other fastenings were used here, or in any other part of the structure. Next, a circular pattern of 12 shorter posts was placed outside of the posts and a series of stringers were laid across their tops. Poles were then laid at an angle from the stringers to the ground, forming a space between the posts and the exterior wall. Finally, rafters were laid from the stringers to the four main support beams to form the roof. Space was left for a doorway, which was constructed in the form of a flat-topped tunnel. Willows and grass were laid over the rafters, and the whole structure was covered with earth. A space was left in the center of the roof as a smokehole. An earthlodge could be expected to last 7 to 10 years, depending upon the care taken in construction, and the quality of timber used.

Settlement Pattern

Permanent or summer earthlodge villages of the Plains Village Tradition were almost invariably located on the terraces, overlooking the flood plain where the gardens were located. All of the resources needed by the villages were confined to a narrow zone immediately adjacent to the Missouri River. Villages were spaced along this zone in a fairly regular pattern. Historically, they were self-sufficient and politically autonomous (Wood 1974:7-8). There was little flexibility in village placement, given the strictly defined zone of necessary resources.

One criterion for village movement was the need for productive garden locations. Since the use of artificial fertilizers was unknown, it was periodically necessary to allow old garderns to lie fallow and clear new segments of forest to find fertile land (Wilson 1917). An even more critical variable in village location was proximity to timber. A large village would consume vast amounts of timber for construction of lodges, palisades, and stages, as well as for firewood. When nearby timber had been depleted, a change in village location would have been necessary, given the critical need for this resource (Griffin 1977).

Plains Village Taxonomy

Middle Missouri taxonomy has undergone several major changes since the turn of the century, when the first speculative investigations began. The difficulty in designing a taxonomic scheme has always been the complexity and time depth of the occupation. The development of Middle Missouri taxonomy with an emphasis on the Knife-Heart Region will be discussed in the following section. This is done with reference to Wood (1969) and Goulding (1979). Wood (1969) has identified three periods in the development of Middle Missouri taxonomy. They are, the period of tribal identification, the period dominated by the Midwest Taxonomic System, and the period of broad conceptual schemes based upon the Willey and Phillips (1958) classification.

The period of tribal identification was pursued from the turn of the century until the late 1940´s (Wood 1969:144-145). Investigators attempted to assign archaeological remains in the Middle Missouri and surrounding areas to known historic tribes. The first major research of this type was conducted at the Double Ditch Mandan site near Bismarck, by Will and Spinden (1906). Double Ditch still stands as a seminal work, based upon a total anthropological approach. The site is still relatively intact today, and is afforded a modicum of protection as part of the North Dakota State Park System. During the 1930´s, W. Duncan Strong employed the Direct Historical Approach in assigning tribal affiliation to archaeological remains on the northern Plains (Strong 1940). His 1940 article is also significant in that it represents the only published account of research conducted at a number of sites in the Knife-Heart Region in 1938. Near the end of this period, Will and Hecker (1944) attempted a synthesis of cultural development in the Knife-Heart Region. They developed a series of stages in Mandan-Hidatsa cultural development. Their work has been superceded by more recent research, but it remains a major reference.

The Midwest Taxonomic System (MTS) dominated Middle Missouri taxonomy from the late 1940´s until 1966 (Wood 1969:145). The system was originally employed in the Midwest and was used on the Plains to provide an organizational framework for large amounts of accumulating data (McKern 1939). The MTS is a content-oriented classification based upon trait similarities. The taxonomic units employed were the, component, focus, aspect, phase, pattern, and base. The MTS was specifically designed to be used without reference to space or time. This was entirely appropriate then, given the rudimentary knowledge of culture history and lack of chronological control.

By the 1950's, salvage excavations in the Middle Missouri were producing large amounts of data, and it became apparent that modifications of the MTS would be necessary. The modifications were introduced by Lehmer when he defined the Plains Village Pattern, and separated the Central Plains and Middle Missouri traditions, which merged in late prehistoric times to form the Coalescent Tradition (Lehmer 1954). The introduction of carbon-14 dating, along with increasing analytic sophistication made it inevitable that space and time designations would be added to the MTS. Lehmer's modifications to the MTS, along with space and time designations became the standard for research in the area (Stephenson 1954). This resulted in the creation of a multitude of foci and aspects. The higher level units were designed for the Midwest and were found to be inappropriate for the Middle Missouri (Wood 1969:145). Most of the papers produced by the Smithsonian's River Basin Surveys, published as <u>Bureau of American Ethnology Bulletins</u>, used this system (Smith and Grange 1958; Cooper 1958; Wheeler 1963; Wood and Woolworth 1964; Woolworth and Wood 1964).

By the mid-1960's, the River Basin Surveys salvage operation was winding down, and it became apparent that substantial modification of the taxonomic system would be necessary in order to accurately reflect space and time. Wood (1969:145-146) identifies this as the period of broad conceptual schemes. Lehmer and Caldwell (1966) proposed acceptance of the time-space oriented Willey and Phillips (1958) classification system. They saw the Middle Missouri as one of three regions in the Northern Plains Subarea of the Plains and cross-cut Lehmer's cultural traditions with horizons (Wood 1969:146). Lehmer and Caldwell's article provided the framework for future investigations. All of the works in the Smithsonian Institution's series Publications in Salvage Archeology utilized the new scheme (Caldwell 1966; Hoffman 1967, 1968; Lehmer and Jones 1968; Smith and Johnson 1968; Caldwell and Jensen 1969).

In 1971, Lehmer's summary of work in the Middle Missouri, An Introduction to Middle Missouri Archeology, was published. In it, he proposed modifications of the Lehmer and Caldwell 1966 taxonomic scheme. He introduced the concept of variant to the literature, replacing the horizons proposed in 1966. The final result was a system of cultural traditions, each containing a series of variants (Table 1). The two major cultural traditions are the Middle Missouri and the Coalescent. The Middle Missouri Tradition peoples were the intitial Plains Village occupants of the valley, with origins to the south and east. The tradition is characterized by long rectangular earthlodges and well made pottery with S-shaped rims and heavy cord impressions. The Coalescent Tradition peoples were later arrivals who migrated from the Central Plains. Their characteristics are circular earthlodges, and pottery with thickened, outflared rims.

Table 1. Major cultural traditions with associated variants and dates as proposed by Lehmer (1971:33 Table 2).

Major Cultural Tradition	Tradition	Variant	Dates
Plains Village	Coalescent	Disorganized	1780-1862
		Post-Contact	1675-1780
		Extended	1550-1675
		Initial	1400-1550
	Middle Missouri	Terminal	1550-1675
		Extended	1100-1500
		Initial	900-1400

The following section will briefly describe Lehmer's model of cultural change in the Middle Missouri. Only the variants will be discussed. Lower level taxonomic units, such as phases, will be described only for the Knife-Heart Region. Lehmer's model will then be contrasted with more recent interpretations in the Knife-Heart Region, resulting from research conducted at and near the KNRI.

Lehmer's Model

The Initial Middle Missouri Variant (900-1400) represents the first occupation of the Middle Missouri by Plains Village peoples. All of the reported sites of this variant are located downstream from the Cheyenne River in South Dakota (Lehmer 1971:Fig. 38). They have rectangular earthlodges and some of the villages are fortified. Initial Middle Missouri origins appear to lie to the south and east, in what is now southwestern Minnesota and northwestern Iowa. Closely related complexes include Great Oasis and Mill Creek in Minnesota and Iowa and Over Focus sites in the James River Valley of South Dakota (Anderson 1969a; Caldwell and Henning 1978:130). The expansion of Initial Middle Missouri peoples to the west and ultimately to the Middle Missouri may have coincided with the Neo-Atlantic climatic episode. This episode was a relatively warm, moist time which would have been favorable for the expansion of horticultural peoples (Lehmer 1970:60). After A.D. 1300, Lehmer believes that the Initial Variant terminates or develops into the Modified Initial Variant, based upon ceramic changes (Lehmer 1971:104). Recent analysis of the materials suggests that the Modified Initial Variant is not a valid taxon (Johnson 1977).

The Extended Middle Missouri Variant is somewhat later in time (1100-1500). These sites are much more numerous than those of the Initial Variant, and they occupy a more northerly geographic position, extending all the way into the Garrison Region (Lehmer 1971:Fig. 39). Prior to the accumulation of substantial numbers of radiocarbon dates, the Extended Variant was thought to be an outgrowth of the Initial. This does not now appear to be the case. Rather, the Extended Middle Missouri occupation represents a separate migration to the Middle Missouri. Near the Cheyenne River, some Extended Middle Missouri sites are fortified, showing evidence of possible conflict with Initial Middle Missouri peoples downstream.

The Initial Coalescent Variant (1400-1550) represents the actual migration of people identified with the Central Plains Tradition to the Middle Missouri, which was already occupied by peoples of the Middle Missouri Tradition. Only ten sites of this Variant have been identified, all clustered in a relatively small area near the Big Bend (Lehmer 1971:Fig. 76). Initial Coalescent earthlodges are usually circular. A detailed description of the evidence for migration of peoples from the Central Plains is provided by Spaulding (1956) in his report on the Arzberger site. The only other excavated Initial Coalescent sites with published results are Black Partizan (Caldwell 1966) and Talking Crow (Smith 1977).

The Extended Coalescent Variant (1550-1675) shows evidence of a population explosion in the Middle Missouri (Lehmer 1977:Fig. 77). The sites are found in considerable density through the valley from the Spain site (Smith and Grange 1958) just below the mouth of the White River to the Demery site (Woolworth and Wood 1964) near the North Dakota-South Dakota border. The expansion of the Extended Coalescent was accomplished at the expense of Middle Missouri Tradition sites. Apparently, the Middle Missouri Tradition peoples retreated upstream in advance of the expanding Extended Coalescent populations. Lehmer's model does not allow for the expansion of Extended Coalescent sites upstream of Demery, but recent research in the KNRI has located materials which appear to be Extended Coalescent (Ahler et al. 1984).

The Terminal Middle Missouri Variant (1550-1675) represents the final manifestation of the Middle Missouri Traditon. Only nine of these sites have been identified (Lehmer 1971:Fig. 79), and of those, Helb (Falk and Calabrese 1973) and Jake White Bull (Ahler et al. 1977) have been reassigned to the Extended Middle Missouri Variant. The remaining seven villages are interpreted to have been under considerable pressure from the Extended Coalescent populations downstream. The elaborate fortifications of Terminal Middle Missouri sites are cited as evidence. The best known and best preserved is the Huff site, located a few miles downstream from Mandan, North Dakota. This site is surrounded by an elaborate fortification ditch with bastions at regular intervals. The houses within are rectangular, and are arranged in rough rows. Wood (1967) has identified the Huff site as an ancestral Mandan village.

The Post Contact Coalescent Variant (1675-1780) consists of villages which all contain circular earthlodges. The long rectangular earthlodges of the Middle Missouri Tradition had been replaced by the circular houses of the Coalescent Tradition. The sites assigned to this variant are quite numerous, and are spread throughout the Middle Missouri (Lehmer 1971: Fig. 82-83). Late in this period, the people in the southern end of the valley can be identified as Arikara, while the Mandan and Hidatsa resided in the northern portion. The three tribes became heavily involved as middlemen in the Euro-American fur trade. They became quite affluent in the process, and in many ways this was the heyday of the villages tribes. Of the sites investigated in this study, Lower

Hidatsa and the lower portions of Sakakawea and Big Hidatsa were identified by Lehmer as Post Contact Coalescent. The ending date of 1780 was chosen as the year of the first well documented smallpox epidemic.

The Disorganized Coalescent Variant (1780-1862) represents the final remnants of the village tribes. When Lewis and Clark ascended the river in 1804, only eight villages were occupied in the vast reach of the Middle Missouri. The rest had succumbed to Euro-American diseases and pressures from surrounding horse nomads. This variant represents a time of increasing dependence for the village cultures, and ends when reservation life began in 1862.

Upper Knife-Heart Region Cultural Sequence

Until recently, it was assumed that the cultural sequence in the Upper Knife-Heart Region conformed to Lehmer's model as described above. However, several years of intensive research in the KNRI and surrounding areas have shown the local sequence of prehistoric activities to be extremely complex. Lehmer's model does not address this complexity in a satisfactory manner. Recent research has focused on interpretation of Mandan and Hidatsa oral traditions as well as detailed excavation data. The most recent summary of this work is contained in Lovick and Ahler (1982:54-78) and will provide the basis for the following discussion. The differences between Lehmer's model and that proposed by Alfred Bowers will be examined in order to properly describe the series of phases for the KNRI area as currently conceived.

Alfred Bowers conducted research in the Middle Missouri for many years, focusing on Mandan and Hidatsa origins and tribal movements. His main emphasis was on oral traditions. He spent years working with elderly Mandan and Hidatsa informants on the Fort Berthold Reservation and supplemented those oral traditions with information gathered from archaeological materials. Some of those materials were gathered from test excavations. In working from oral traditions, Bowers employed the Direct Historical Approach. Using this method, one works from history to prehistory in order to establish historic tribal movements and identities (Wedel 1938; Strong 1940; Wedel and DeMaille 1980). His work was reported in his dissertation (1948) and in studies of the Mandan (1950) and Hidatsa (1965). Lehmer, by contrast, worked from the opposite direction, using the mass of archaeological data gathered by the River Basin Surveys to describe tribal movements and developments. Bowers´ research emphasis lay in the northern end of the Middle Missouri, while most of Lehmer´s work emphasised the southern part of the area. After the River Basin Surveys had concluded, Lehmer began research in the Upper Knife-Heart Region (Wood n.d.; Lehmer et al. 1978) but it was cut short by his death in 1975.

Bowers´ Model

Bowers approached his study of the cultural sequence in the Knife-Heart Region with the knowledge that both the Mandan and Hidatsa were composed of distinct subgroups. The following discussion of his model was synthesized by Lovick and Ahler (1982:61-63) from his work (Bowers 1948; 1950; 1965). He found that the Mandan were divided into two subgroups after their collective arrival on the Missouri sometime prior to 1300. One group stayed in the Heart River area, living in rectangular earthlodges. Bowers divides their occupation into three foci, the Cannonball, Huff, and Heart River. The southern subgroup moved far to the south and settled on the tributaries of the Black Hills. By about 1500, they had moved back to the Middle Missouri having adopted the use of circular earthlodges and pottery with tool-impressed decorations. The southern group then began a northward movement which eventually took them to and beyond the northern Mandan group near the Heart River. Their movement north past the northern Heart River group would account for the presence of sites such as Lyman Aldrin and Motsiff, which exhibit circular houses and tool impressed pottery. The northern and southern groups then blended over a period of time to form the single Mandan cultural pattern of the historic period. Bowers divides the southern Mandan group into three chronologically sequential foci, the Lower Grand, Upper Grand, and Heart River.

While the southern Mandan group was moving north into the Upper Knife-Heart Region, the first of three Hidatsa subgroups arrived in the valley. The three groups were the Awatixa, the Awaxawi, and the Hidatsa Proper. They all spoke distinct dialects of a Siouan language and had distinct origin traditions (Wood 1980:4).

The Awatixa apparently came from the east, but their origin traditions maintain that that they had always been in the Missouri valley. They believed that their ancestors had come from the sky and landed at Charred Body Creek, located a few miles downstream from present day Washburn, North Dakota (Bowers 1965:21). They settled at Scattered Village, a site which Bowers (1948:114) describes as extending from the present Lower Hidatsa site to the Knife River bank. Eventually, they moved to a concentrated village, which we know today as the Lower Hidatsa site. After the abandonment of Lower Hidatsa about 1780, the Awatxa attempted a joint occupation at Rock Village (32ME15) with the Hidatsa Proper, which ultimately failed due to conflicts over bundle rights and the jealousy of the chiefs (Bowers 1965:27). They then established Sakakawea village, after 1797, and before 1804 (Ahler et al. 1980:12-13). In 1804, the Lewis and Clark expedition found the Awatixa Hidatsa at Sakakawea village.

The Awaxawi subgroup has oral traditions which suggest origins to the southeast at which time they were allied with the River Crow and Hidatsa Proper. After separation from those groups, they lived for a time at Devils Lake before coming to the Missouri Valley. They arrived in the Painted Woods area, downstream from Washburn, North Dakota on the east bank of the Missouri. The Awaxawi can be associated with three earthlodge villages in the Upper Knife-Heart Region (Wood 1980:31). These are Molander (32OL7), Mahaha (32OL22), and Amahami (32ME8). The Amahami site is of greatest interest here since it is located adjacent to the southern boundary of the KNRI. All that remains of the site is a single earthlodge depression in the front yard of the Mercer County Courthouse.

The Hidatsa Proper have origin traditions similar to the Awaxawi. They describe an origin to the southeast, and a period of residence at Devils Lake. They separated from the River Crow after arrival on the Missouri, in what was apparently a slow process over a long period of time (Wood 1980:35; Wood and Downer 1977). The Hidatsa Proper are still considered by the Crow to be one of their bands (Bowers 1965:13). They settled at a large village on the north bank of the Knife River, which can be identified as the Big Hidatsa site.

Bowers places the Hidatsa sites in two chronologically sequential foci, the prehistoric Painted Woods, and the post-contact Heart River. The Painted Woods Focus contains the pre-contact Awaxawi and Awatixa sites which were near and contemporary with the Upper Grand Mandan groups. The Mandan and Hidatsa engaged in intensive sharing of lifeways. This resulted in the adoption by the Hidatsa of many Mandan traits. The Heart River Focus contains all the post-contact Mandan and Hidatsa groups, engaging in an intensive process of sharing and assimilation. Lehmer acknowledged the major role of sharing and assimilation by placing all the post-contact groups in the Post Contact Coalescent (Lovick and Ahler 1982:63).

Contrasts

There are a number of clear differences between the Bowers and Lehmer models (Lovick and Ahler 1982:63). First is Lehmer's definition of the Extended Coalescent as an intrustion of Caddoan immigrants from the south coming into conflict with the established Siouan proto-Mandan cultures. Bowers defines the same thing as movements within the early Mandan cultural tradition or the Lower and Upper Grand foci. He sees all of the cultural sequence from the Cheyenne River north as interactions within the Mandan cultural tradition.

The major problem with Lehmer's interpretations of these movements is the inability of his model to account for any Extended Coalescent materials north of the Caddoan migration front, marked by the Demery site on the North Dakota-South Dakota border (Lovick and Ahler 1982:63). But sites such as Lyman Aldrin, Motsiff, and materials from the KNRI have Extended Coalescent characteristics. They can be predicted by using Bowers' model, which would explain them as products of the southern Mandan group moving past the northern Heart River Mandan groups. The Bowers model may therefore have more utility. Also, Lovick and Ahler (1982:64) believe that Lehmer may have incorrectly identified a Coalescent Tradition when none exists, at least in the sense intended by Willey and Phillips. He certainly identifed the process of coalescence which occurred on several occasions, but not an actual Coalescent Tradition.

In the KNRI area, Bowers' model seems quite useful. However, the complexity of the local sequence is more than can be accounted for in his scheme of tribal subgroup movements. Therefore, the current sequence for the KNRI consists of a series of phases or units, without specific reference to either the Lehmer or Bowers models. A summary of the phases and their position within the Lehmer and Bowers systems is provided in Table 2.

Table 2. Taxonomic units developed for the KNRI with reference to Lehmer and Bowers´ models (Lovick and Ahler 1982:66 Table 2).

KNRI Taxonomic Units	Placement in Lehmer´s Model	Placement in Bowers´ Model	Approximate Age A.D.
Clark´s Creek Phase	Middle Missouri Tradition	Cannonball Focus	1000-1200
Nailati Phase	Middle Missouri Tradition	Painted Woods Focus	1200-1400
Heart River Phase	Coalescent Tradition	Heart River Focus	1400-1710
Scattered Village Complex	?	Upper Grand & Painted Woods Foci	1400-1700
Unnamed Phase Protohistoric	Coalescent Tradition	Heart River Focus	1710-1750
Knife River Phase	Coalescent Tradition	Heart River Focus	1750-1861

Clark´s Creek Phase

This phase was originally defined by Wood (n.d.) on the basis of excavations at the Clark´s Creek site (32ME1). No other excavations at Clark´s Creek Phase sites have been undertaken. It is characterized by rectangular earthlodges, and open, unfortified village plans. The pottery assemblage consists of high frequencies of straight-rim Riggs Ware, and S-Rim Fort Yates ware. There are no

Clark's Creek Phase sites in the KNRI, although the Stiefel site (32ME202), located ca. 2 miles west of the KNRI on the Knife River belongs to this phase (Lovick and Ahler 1982:70-71). The Stiefel site is unusual, in that very few Plains Village sites are found up tributaries away from the Missouri River. Analysis of the pottery from Stiefel and comparison with the Jake White Bull (Ahler 1977) and Helb (Falk and Calabrese 1973) assemblages suggests that a date of A.D. 1000-1200 is reasonable (Ahler and Swenson 1980:90). This phase is poorly known, and will remain so until another component, like the Stiefel site, is excavated.

Nailati Phase

The Nailati Phase is also characterized by rectangular earthlodges and open, unfortified village plans. At the type site (Cross Ranch, 32OL14) two rectangular houses were excavated (Calabrese 1972). The site is located on a terrace adjoining a precipitous drop to the Missouri River. Several Nailati Phase sites are known from the KNRI, but only the nearby White Buffalo Robe site (Lee 1980) has been excavated (Lovick and Ahler 1982:71). The carbon-14 dates from the Cross Ranch and White Buffalo Robe sites cluster well, suggesting dates of 1200-1400. However, the Le Beau S-Rim ware from the Cross Ranch site has been reclassified as Fort Yates ware, on the basis of information from the White Buffalo Robe site (Lee 1980).

Heart River Phase

The Heart River Phase was originally defined by Lehmer (1971:203-204) with dates of 1675-1780. He proposed two subphases, Heart River 1 (Mandan) and Heart River 2 (Hidatsa). The Mandan sites were clustered to the south while the Hidatsa sites were located upstream, near the Knife River. Tribal assignments were made with reference to historic documents, since it is not possible to make tribal assignments at Heart River sites on the basis of archaeological data alone.

The Heart River Phase is characterized by circular earthlodges. In most cases, this information is derived from surface indications. The overall village plan is compact, with houses very close together. The intensity and duration of occupation often produces very large midden piles, as is the case at the Double Ditch site. The pottery assemblage is dominated by Le Beau S-Rim ware. This pottery is distinctive and well made, often exhibiting prominent cord impressions. In the Heart River Phase component at White Buffalo Robe (Lee 1980:224) and Lower Hidatsa (Ahler and Weston 1981:106) the percentage of Le Beau S-Rim ware is 72.2% and 92.6% respectively.

Recent evidence indicates that the phase is much longer than Lehmer's original definition. It has been concluded that dates of 1400-1710 are reasonable. The beginning date of 1400 is based on carbon-14 dates from White Buffalo Robe, while the ending date of 1710 is based upon the appearance of Euro-American trade items in the Lower Hidatsa deposits (Lovick and Ahler 1982:72-73).

Scattered Village Complex

The Scattered Village Complex is defined in Lovick and Ahler (1982:73-75), and was created to account for many small sites in the KNRI with no obvious connections to any established taxonomic units. Nine of these small sites have been test excavated (Ahler and Mehrer 1984), and a possible Scattered Village Complex component was identified at the Elbee site (Ahler 1984).

The Scattered Village Complex dates from 1400-1700 and a number of characteristics have been identified. The sites exhibit scattered village plans with idefinite boundaries and no evidence of fortifications. There is little surface expression of houses and the thin site deposits would argue for short term occupation. The site assemblages contain a distinctive pottery assemblage, and exhibit significant frequencies of non-Knife River Flint lithic materials (Lovick and Ahler 1982:72).

With a few notable exceptions, all of the sites in this complex lie within the KNRI. A component similar to the Scattered Village complex was excavated at the Mondrian Tree site (Toom and Gregg 1983) as well as at the Bagnell site (Lehmer et al. 1973) and at the Stanton Ferry site (Ahler and Swenson 1980). This complex would encompass what Bowers referred to as the Scattered Village site, located south and east of Lower Hidatsa (Bowers 1948:114). Yet another Scattered Village site was identified by Will (1924:315) and Will and Hecker (1944:101-102) as a traditional Hidatsa village within the city limits of present-day Mandan, North Dakota.

Unnamed Phase, Protohistoric

This phase dates from 1710-1750 and is defined on the basis of a single excavated component at the Lower Hidatsa site (Ahler and Weston 1981). The starting date of 1710 corresponds to the introduction of Euro-American trade items. The pottery assemblage is dominated by Le Beau S-Rim ware, but with a significant percentage of Transitional S-Rim ware, which exhibits characteristics of both Le Beau S-Rim and the subsequent Knife River ware (Ahler and Weston 1981:62-64). Transitional S-Rim ware is quite similar to Pingree Wedge-Rim ware, associated with the Stutsman focus in the James River Valley (Wheeler 1963:195-196). This would lend support to the oral traditions suggesting Hidatsa origins to the southeast of the KNRI. Transitional S-Rim ware has also been found at the Midipadi Butte site (32DU2) on Lake Sakakwea in the Garrison Region (Kuehn et al. 1984). The ending date of 1750 is marked by major ceramic changes and other cultural disruptions which may be indicative of an early epidemic.

Knife River Phase

The Knife River Phase was originally defined by Lehmer (1971:205-206) as dating from 1675-1780 and it was more fully described by Lehmer et al. (1978). Lehmer and his associates divided it into two subphases, Knife River 1 (Mandan) and Knife

River 2 (Hidatsa). In all cases, the assignment of tribal identity was made with reference to historic documents. As was the case in the earlier Heart River Phase, no distinction between Mandan and Hidatsa sites can be made on the basis of archaeological evidence alone, illustrating the level of sharing and assimilation between the two tribes.

The Knife River Phase contains all the protohistoric and historic Mandan and Hidatsa groups during a time of major cultural change. They were being drawn into the Euro-American fur trade, and that involvement brought new technology into their lives. Traditional industries such as pottery and modified bone show dramatic changes during this time as they were being replaced with metal substitutes. During the same period, the villagers were decimated by a series of smallpox epidemics, greatly reducing their numbers. They were forced to adopt a more defensive settlement pattern, with a few heavily fortified villages, each containing houses packed closely together. This was necessary not only because of the diseases and resulting population reductions, but also because of pressure from mounted nomadic groups who had not suffered so greatly from the epidemics. All three of the sites analyzed in this study have at least part of their occupation in this phase and it will receive major emphasis in later chapters.

Recent analysis indicates that the dates for the Knife River Phase should be expanded to 1750-1861 (Lovick and Ahler 1982:76-78). The beginning date of 1750 is based on stratigraphic changes at the Lower Hidatsa site. At that time, major alterations in ceramics are evident in a shift from Le Beau S-Rim ware to Knife River ware. From this change, an early smallpox epidemic is inferred. Support for a pre-1780 epidemic is found in Truteau´s 1795 account of the Arikara enduring previous epidemics (Nasatir 1952:299). The ending date of 1861 marks the year when the last group of Arikara left Fort Clark to begin reservation life with the Mandan and Hidatsa at Like-a-Fishhook Village.

EURO-AMERICAN CONTACT

Euro-American contact was a major source of influence upon the village tribes of the Middle Missouri. Prior to contact, their villages were self sufficient and independent with a stable food supply based upon gardening and bison hunting. They were heavily involved in a wide ranging aboriginal trade system with contacts reaching over most of the continent. The initial stages of contact brought Euro-American goods into this system, and affluence for the village tribes. However, contact was eventually disastrous. It brought new technology, which replaced native industries, and it brought epidemic diseases for which the Indians had no immunity. As contact progressed, they were increasingly drawn into the Euro-American economic system, by their participation in the fur trade. The Indians came to depend on the traders for goods which they could no longer produce for themselves, establishing dependency well before the beginnings of reservation life.

In the following chapter, the pre-contact social and ceremonial structure of the Hidatsa will be discussed, followed by a discussion of the processes and consequences of Euro-American contact. This will involve a discussion of the aboriginal trade system, and how the Euro-American fur traders took advantange of it. The fur traders first came to the villagers overland from Canada, and after the Lewis and Clark expedition, in greater numbers up the Missouri from St. Louis. The consequences of contact can best be described as resulting from the process of acculturation. This process and its relevance to this study will be discussed at the conclusion of the chapter.

Pre-Contact Social and Ceremonial Life

The following discussion will focus on the Hidatsa, as they occupied Lower Hidatsa, Sakakawea, and Big Hidatsa villages. Mandan social and ceremonial life is quite similar. In the long period of association described in the previous chapter, the Hidatsa acquired not only much of the Mandan material culture, but also a very similar structure of society and ritual. This structure has been examined in detail for the Mandan (Bowers 1950; Bruner 1961), for the Hidatsa (Bowers 1965; Wilson 1917; 1924; 1928; 1934), and for all the river tribes (Meyer 1977). The information in all these sources was gathered primarily from elderly informants on the Fort Berthold Reservation. Some of them had been born in the villages at the mouth of the Knife River prior to the establishment of Like-A-Fishhook village. They retained knowledge of pre-contact lifeways which have since been lost.

Hidatsa social organization was matrilineal. They were predominantly matrilocal in residence pattern, although this did change late in the contact period after the Hidatsa population had been drastically reduced by disease (Hanson 1983). Descent was calculated through the mother's lineage, with strictly defined means of classifying and referring to relatives (Bowers 1965:80-90). The earthlodges were owned by the women, and were inherited through the female clans (Meyer 1977:61). This system dispersed males to other households and villages, fostering ties and alliances with people who might otherwise have been enemies. The women stayed in place, maintaining stability in households and gardening. This stability, coupled with location and trading connections, made the Hidatsa and the Mandan favored clients for Euro-American traders.

Like the Mandan, the Hidatsa had a series of matrilocal exogamous clans, divided into two unnamed moieties (Bowers 1965:64-65). The Awatixa had 13 clans, while the Awaxawi and Hidatsa Proper each had a 7 clan system. Some of the Hidatsa clans were equated with Mandan clans, especially after joint residence began at Like-A-Fishhook village. In contrast to the Mandan, Hidatsa moieties were not exogamous. The clan names were derived from individuals and events in oral tradition, believed to have taken place since the time of residence in the Missouri Valley. The clans served an integral role of support and discipline within the community. They regulated marriage, took care of needy members, settled disputes, and undertook the social control and education of their younger members. An exception was a young man's religious or ceremonial training, which was undertaken by members of his father's clan (Meyer 1977:73). Clan and tribal ceremonies were based upon sacred bundles, each of which contained a number of items used in ceremonies. These bundles were cared for by individual clan members who had inherited the rights to their use. Among the Mandan, bundle ownership was determined through descent in the female line from the current bundle holder. The Hidatsa practiced a system by which bundle ownership was passed from father to son (Meyer 1977:73).

In addition to the clans, the Hidatsa had a series of secular societies, grouped roughly by age. These were age-grade societies and reflected Hidatsa belief in the importance of relative age in regulating behavior among community members (Bowers 1965:174-175). The societies had formal names, symbols, songs, and rules of behavior. This was especially true for the men, whose age-grade system was a grouping of military societies. The most important of these was the Black Mouths, a society of middle-aged men who served a police function in the village (Meyer 1977:74). Membership in any given society was collectively purchased by the next younger group. The purchase included rights to all ceremonial symbols and rituals. All other ceremonial knowledge was passed in a similar manner, by purchase. This was also true of utilitarian knowledge or practical skills, such as pottery making (Meyer 1977:81). The same was true for the Mandan, where technical knowledge concerning manufacture of utilitarian objects had to be purchased from specialists (Bruner 1961:22). This concentration of knowledge in the hands of specialists contributed to dislocations after population reductions in smallpox epidemics.

Village leadership was vested in the senior lineage and clan leaders (Bowers 1965:40-42). One was chosen as war chief, based upon his past military exploits. Another was designated as peace chief, based upon his standing in the community, and ability to resolve conflicts in an agreeable manner. Thus there was no single leader in the Euro-American model, capable of speaking for everyone.

As will be discussed below, the traders set out to change this pattern after contact.

The Hidatsa social and ceremonial system provided a stable and structured environment for all its members. Family ties and ceremonial obligations were well defined. Means for social advancement were available, but they were rigidly defined, and it could take most of a lifetime to advance to positions of social prominence. Elders within the system were highly respected, having attained power through a long and difficult process. Power was acquired through fasting, participation in ceremonies, self-torture, receiving visions, giving feasts to the bundles, and inviting older men to have sexual intercourse with one´s wife (Bruner 1961:228). This last method of obtaining power was grossly misunderstood by the traders, who assumed all Mandan and Hidatsa women to be prostitutes, when in reality the village men were attempting to acquire some of the traders´ power through an accepted means (Bruner 1961:217). Euro-American contact brought a market-oriented economy to the Hidatsa, along with new technology and disease. In the process, new paths of advancement were created, bypassing the rigid structure described above. These factors combined to radically change, and then destroy most of the social system. The process by which this occurred will be described in the following section.

Aboriginal Trade

Prior to Euro-American contact, the Hidatsa, Mandan, and Arikara were all involved in a wide ranging aboriginal trade network. It was well developed, with established centers as well as temporary trading fairs without fixed locations. When the Europeans arrived, they funneled their goods through the established system in return for the furs which were so valued in their own culture. The trade system was, therefore, the means by which Euro-American contact came to the villages of the upper Missouri. The following section will describe the trade system on the northern Plains as it existed on the eve of Euro-American contact.

In the villages of the Middle Missouri, there is abundant evidence of pre-contact aboriginal trade with groups far removed from the northern Plains (Wood 1980:99). For example, Dentalium shells from the Pacific coast have been found in the KNRI at both the Lower Hidatsa and Big Hidatsa villages (Ahler and Weston 1981:161-164; Ahler and Swenson 1985:217). Exotic items such as these indicate that the villagers were in contact with distant tribes. However, archaeological evidence of trade presents only a limited picture of the total system. A more complete understanding may be achieved only with reference to the surviving journals of early fur traders and explorers on the upper Missouri (Ewers 1968:15).

The aboriginal trade system of the northern Plains was not a haphazard collection of trails and chance meetings between groups. Rather, it was a highly structured system of established trading centers, and subsidiary temporary trading locations. Wood (1980:99) sees it as a series of dynamic systems, each containing a series of independent subsystems, using the terminology defined by Clarke (1978). The two main systems were the Pacific-Plateau, and the Middle Missouri. The Pacific-Plateau system was based at The Dalles Rendevous, which took place each fall. The rendevous was permanently located at The Dalles of the Columbia, where the Columbia River passes through the Cascade Mountains. At this location, the river is constricted into a narrow gorge, and forms a long series of cataracts. The cataracts form a natural bottleneck, impeding the migratory salmon, swimming upstream to spawn. The Dalles thus provides an ideal location for the seasonal procurement of large quantities of fish. Nearby tribes such as the Wishram and Wasco took advantage of their location and harvested the salmon. The Dalles Rendevous was also located at a strategic cultural point. The Plateau tribes and other groups from the Columbia drainage traded there, passing on items obtained from the Great Basin, Pacific Coast, and northern Plains. Lewis and Clark observed the exchange of huge quantites of dried fish, as well as hides, furs, clothing, and many other items (Wood 1980:101-102). Dentalium shells such as those found in the Knife River Hidatsa villages probably passed through The Dalles Rendevous.

The Pacific-Plateau system interacted with the Middle Missouri system at the Shoshone Rendevous, held every spring. It was not held in a fixed location, and is considered ancillary to the main trading systems. It was probably located in southwestern Wyoming, and attracted tribes such as the Nez Perce from the Plateau, the Utes from the Southwest, and the Crows from the northern Plains, among others (Wood 1980:102). Since it was held in the spring, and the Pacific-Plateau and Middle Missouri systems operated in the fall, the Shoshone Rendevous served as a seasonal means of transferring goods from one major system to another (Wood 1980:102).

The Middle Missouri system operated with two major locations, the Arikara villages in South Dakota, and the Mandan-Hidatsa villages of the Knife-Heart Region. The Mandan and Hidatsa villages are considered to be one unit in the trading system. The Mandan and Hidatsa traded with the Crow from the west, and with the Cree and Assiniboine from the northeast. They also maintained trading relationships with the Teton Dakota, by way of the Dakota Rendevous. Like the Shoshone Rendevous, it did not operate in a fixed location, but was situated in what is now southeastern South Dakota (Wood 1980:100). Another trade route moved to the Mandan-Hidatsa system from the southwest over the High Plains by way of the Cheyenne, Arapaho, Comanche, and other nomadic groups (Wood 1980:102). The Mandan and Hidatsa were thus firmly tied to far flung parts of the continent through a well developed trade system.

A series of trade relationships were developed in order to facilitate large-scale trading (Wood 1980:104-105). Tribal warfare on the northern Plains was a constant factor. trade was conducted for need and for profit, and it benefited all groups, so some means to circumvent warfare while trading had to be devised. The solution was a market truce, whereby all groups could trade at the Mandan-Hidatsa villages, even those with whom the villagers were at war.

As soon as the traders were away from the villages, warfare could resume. Kinship ties were very important for the village peoples. To facilitate trade and minimize hostilities, fictive kinship ties with members of other groups were created. A network of these fictive kinship ties existed across the northern Plains. The ties were created when traders were "adopted" by individuals from other tribes. Language was another potential impediment to trade, given the number of languages and dialects on the Plains. One solution was for traders to be multilingual. This was especially critical for groups active as middlemen in the trade, such as the Mandan and Hidatsa who were noted for their linguistic ability (Bruner 1961:201). Where multilingual speakers were not available, the widespread Plains sign language made communication possible.

The vast majority of items traded by the Middle Missouri villagers and their nomadic neighbors prior to contact were perishable, and are not preserved in archaeological sites. This includes garden produce, hides, meat, and skin clothing. The villagers and the nomads exchanged items that each group was capable of producing, since they exploited different parts of the same ecosystem (Wood 1980:103). The villagers could and did hunt bison, while the nomads could plant and cultivate gardens. However, trade between them intensified their specialties (Ewers 1968:22). The nomads processed more hides and meat so as to trade for garden produce while the villagers produced larger surpluses of garden produce to trade to the nomads for the products of the hunt. A wide variety of exotic items such as shells from the Pacific coast and distant lithic raw materials were also traded. The trading fairs also promoted the exchange of people and ideas, as well as objects. This contributed to a certain amount of cultural leveling and enhanced the similarity in material culture between nomads and villagers (Wood 1980:106). The trading system was in place long before the arrival of the Euro-Americans, and when they arrived, it provided the means for the rapid movement of people, new technology, and disease.

Euro-American Fur Trade

The fur trade moved across North America in response to demand for the fashions of the day. Fur hats were in fashion in America as well as in Europe. The demand for furs, especially beaver, was strong enough to make it profitable for commercial concerns to penetrate the North American interior. The fur traders brought the Euro-American concept of a market economy with them. This was a totally foreign idea for the Indians of the northern Plains, as well as those in other parts of the continent. The traders offered unfamiliar technological items in return for furs, especially those of the beaver. The trader's items rapidly gained enormous value among Indian tribes, although they were of rather low value in the traders' culture. The tools and trinkets provided by the traders gradually replaced items of native manufacture. The Indians then became dependent upon the traders. The furs provided to the traders were of great commercial value, and a spirited competition developed for the furs from the northern Plains.

Along the eastern seaboard of North America, Indian tribes came into contact with Euro-Americans at about the same time that they received Euro-American technology. The situation on the northern Plains was much different, where the Indians received Euro-American goods well before making actual contact with white traders. Commercial concerns from France, England and, later, from the United States competed to exploit the remote area long after contact had been made with the eastern tribes. The fur trade on the northern Plains has been described in great detail by Chittenden (1902) and Nasatir (1952) among many others. The following description will focus only on the portion of the fur trade which affected the Knife-Heart or Mandan-Hidatsa region of the Middle Missouri.

Spatial Structure of the Fur Trade

The fur trade was initiated on the northern Plains by French and British companies which pushed from the Atlantic seaboard across Canada. Their operations involved not only Euro-American employees, but also numerous Indian tribes. The effects of this trade was felt by the Indians during what is traditionally referred to as the protohistoric period. It begins with the initial receipt of Euro-American goods, and ends with the Historic period, when permanent local trading posts were established. Arthur Ray (1978) has constructed a model of fur trade spatial structure during the protohistoric period, based upon the activities of Euro-American traders and the Indian tribes with which they interacted.

In the first stage of contact, Euro-American trading posts are established (Ray 1978:26). Shortly afterward, the Indians in the area take on the roles of hunters, trappers, and traders. They interact and trade directly with the Euro-Americans at the post, exchanging furs that they have procured for trade items. In a relatively short period of time, they become heavily dependent upon the traders for technolgical items which they can no longer manufacture for themselves. The nearby peoples generally visit the trading post several times a year, and the local fur bearing animal population is soon depleted, forcing the hunters and trappers to move farther into the interior (Ray 1978:26).

Later in the Protohistoric period, the actual trading takes place farther from the post, and is in the hands of Indian trade specialists or middlemen (Ray 1978:26-28). This is referred to as the Middlemen Trade Zone and is used entirely by Indian traders who obtain Euro-American items from the trading posts, and exchange them with tribes of the interior. They do not trap and hunt the fur bearing animals themselves, but rather acquire them from distant interior tribes. The Middlemen Trade Zone was generally located in an area where groups could safely make one trip per year to the trading post (Ray 1978:28).

At a greater distance still were the tribes of the interior, in what Ray (1978:28) calls the Indirect Trade Zone. The groups in this area had no contact with the Euro-American traders. They traded only with the Indian middlemen, who had in turn acquired their goods from the traders. They were too far from the trading posts to travel there directly, and they were often discouraged from doing so by the middlemen, anxious to protect their own positions.

The Indian middlemen did not behave in the manner expected by their Euro-American suppliers. Instead of purchasing large quantities of goods to trade with the interior tribes, they only took as much as they needed for their own uses (Ray 1978:30). The Euro-American goods which they did pass on to the interior tribes were thus used, usually at least a year old. The middlemen sold these used goods at a substantial markup over their original cost at the trading posts.

The archaeological implictions of this model are considerable. Since the middlemen used their trade goods and then passed them on to others, very few trade artifacts would be expected in Protohistoric sites, despite intense trade activity (Ray 1978:32). A more traditional interpretation would hold that the low numbers of Euro-American trade items is indicative of limited trade contacts.

The number of trade items can be expected to rise sharply in the final period, that of Direct Trade (Ray 1978:32). This corresponds to the Historic Period, where trading posts are established locally, and Indian groups begin interacting directly with the traders, without middlemen as intermediaries. Indian groups on the northern Plains went through all of these periods as the contact frontier moved west and south from Canada. Ray (1978:Fig. 2) sees the margin of the Indirect Trade Zone as being past the Mandan-Hidatsa villages by 1700. By then, they were receiving at least some Euro-American trade items from Cree and Assiniboine intermediaries. The Mandan and Hidatsa functioned as middlemen later in the protohistoric period, moving tremendous quantities of materials through their villages. The Direct Trade Period came for the villagers with the establishment of permanent trading posts in the Upper Knife-Heart Region after the Lewis and Clark expedition of 1804-06. The following section will describe the processes and consequences of the fur trade for the Mandan and Hidatsa, with reference to Ray's (1978) model.

Development of the Fur Trade

The intitial fur trade contacts with the Mandan and Hidatsa came from the northeast. It was based in Canada and developed prior to any contact from trading concerns downriver. The down river system was based in St. Louis, and was dominated first by the Spainards, then by the French, and finally by the Americans (Wood and Thiessen 1985:3). The route taken by the Canadian fur traders was overland, across what is now southern Manitoba and central North Dakota. This trade was very important, in that it established intital contacts with Euro-Americans, their technology, their market economy, and their diseases. In many ways, it was a taste of things to come.

The Canadian fur trade was a profitable commercial enterprise, and it was dominated by two large companies, the Hudson's Bay Company, and the North West Company. Between them they controlled

93 percent of the Canadian fur trade. Their rivalry and business competition was intense, and ended only when the North West Company was absorbed by the Hudson's Bay Company in 1821 (Wood and Thiessen 1985:8).

The North West Company was formed in the mid-1700's, and consisted of a series of shifting partnerships. It was based in Montreal, and was connected to its western trading areas by a long waterway route. This route moved down the St. Lawrence River, through the Great Lakes, and through the system of interconnected lakes and rivers of southern Canada. In order to provide a base for operations, the company established a series of posts north and west of the Great Lakes. trade supplies moved out to the posts by canoe, and furs traveled back along the supply route to Montreal, where they were shipped to the fur markets of Europe (Wood and Thiessen 1985:8-9).

The Hudson's Bay Company was an older English firm. It was founded in 1668, and received its Royal charter in 1670. The company was governed by a board of directors in London, and initially confined its activities to the construction of permanent trading posts on the shores of Hudson Bay. From these posts, the traders waited for the Indians to come to them, relying on the services of Indian trading specialists. This strategy was successful for a time, but finally the company was forced to move into the interior to meet the intense competition from the North West Company (Wood and Thiessen 1985:9). The Hudson's Bay Company is still in operation today, and its department stores are a fixture in Canadian cities.

Both companies established posts near the mouth of the Souris river. The Hudson's Bay Company established Brandon House by 1793. This post became a major outpost for the company, and the subject of great interest since journals kept by its agents are preserved today. The North West Company also established a series of posts in the area starting in 1795 (Wood and Thiessen 1985:10-11). It was from these posts that traders were sent to the Mandan and Hidatsa villages on a regular basis.

Indirect Trade Period

Euro-American trade goods began to move into the interior from the shores of Hudson Bay through the aboriginal trade system described above (Wood 1980). The system was in place, and obviously well developed when Euro-American traders first arrived in Canada. They recognized its commercial value, and were quick to move their goods into the system, as a means of reaching tribes well beyond their immediate reach (Ray 1978).

Prior to contact, the Cree and Assiniboine traded with the Mandan and Hidatsa, obtaining goods from the villagers, as well as items traded from tribes to the south and west. The Cree and Assiniboine came into early, direct contact with the Euro-American traders in the vicinity of Hudson Bay. From the traders they acquired unfamiliar goods, such as axes, knives, kettles, cloth, and beads. These items rapidly acquired great value in the Indian world, and were traded into the interior, along the existing trade routes of the pre-contact system. The Cree and Assiniboine thus became the Mandan and Hidatsa's source for Euro-American trade goods, long before the villagers had ever seen a white person.

The role of the Cree and Assiniboine as intermediaries between the Mandan and the Euro-Americans on Hudson Bay has been questioned by Ray (1974). He believes that the Mandan traveled to Hudson Bay between 1670 and 1720, passing through Assiniboine territory. furthermore, he proposes that the trade between the villagers and the Cree and Assiniboine was essentially an historic phenomenon, as there would have been nothing of value for the groups to trade prior to the introduction of Euro-American goods (Ray 1974:89). Wood and Thiessen (1985:18-19) believe it extremely unlikely that the Mandan journeyed as far as Hudson Bay. Not only was the bay at a great distance, but the journey would have required a long passage in canoes, a craft with which the Mandan were not familiar. It is much more likely that the Cree and Assiniboine were middlemen between the villagers and the traders, using a trading system which was in place well before contact. There is clear evidence that the Mandan visited the Assiniboine River trading posts in the 1760's, and it is possible for trade goods to have reached the Mandan and Hidatsa at any time after the establishment of Hudson's Bay Company posts on the bay in 1670 (Wood and Thiessen 1985:21). At that time, the Mandan and Hidatsa were within the Indirect Trade Zone, and in all probability had no contact with Euro-Americans. This situation continued until the 1780's, when regular contacts with Candadian traders were established. At that time, the villagers moved into a role as middlemen, moving Euro-American goods through the trade system.

Initial Contact

During the period of indirect contact, the Mandan and Hidatsa had no contact with Euro-American traders, and received their trade goods through Cree and Assiniboine intermediaries. This changed in 1738, through French interests in the fur trade. The French were interested in the commerce and profits of the fur trade, but they were also seeking a passage to the "Western Sea". This corresponded to the English search for the Northwest Passage, or convenient water route to the Pacific. As the French moved their trading operation inland from eastern Canada, they moved along the interconnected rivers and lakes of southern Canada with little conception of the continent's true size. They believed that a quick water passage to the Pacific existed and could be located by visiting the Mandan country (Smith 1980:3-4).

The appointment of Pierre Gaultier de Varennes, the Sieur de La Vérendrye as commandant of the posts of the north in 1727 rapidly accelerated the movement of the French into the interior (Wood and Thiessen 1985:22). He had a keen interest in exploration, and in contact with the Mandan and Hidatsa. The village tribes were known to La Vérendrye, through stories related by the Cree and Assiniboine of their distant trading partners. He established a series of trading posts on the streams of southern Canada, in what was then part of New France. One of these posts was located on the north bank of the Assiniboine River, near the present town of Portage La Prairie, Manitoba. It was called Fort La Reine, and was the launching point for the first Euro-American expedition to contact the Mandan (Wood and Thiessen 1985:22).

Although La Vérendrye was aware of the Mandan and Hidatsa, the Cree and Assiniboine were reluctant to allow him to make direct contact with the villagers. This is understandable, since they were bound to lose some of their lucrative middlemen role if Euro-Americans established direct trading relationships with the Mandan and Hidatsa (Smith 1980:74). La Vérendrye traveled overland from Fort La Reine with a party of 52 French traders and over 500 Assiniboine. They arrived at a Mandan village near the Missouri River on December 3, 1738 (Burpee 1927 in Bruner 1961:198). This is important as the initial contact between two cultures. The Mandan were finally able to see the source of the trade goods which were so prized. Meyer (1977) refers to this meeting as the "fatal impact," or the beginning of the process by which the village cultures were to be all but destroyed.

La Vérendrye had heard a variety of things about the Mandan, most of them fairly accurate. One fanciful story though, held that they were light-skinned, had chestnut hair, and were of Welsh ancestry (Meyer 1977:19). He found that the Mandan looked much like the other Indians he had seen, although they did live in substantial earth and timber lodges. His description of the village is often quoted, and describes the closely spaced circular earthlodges surrounded by a fortification ditch (Meyer 1977:20). He also described the richness of Mandan material culture, and commented on the intensity and quantity of trade between the Mandan and Assiniboine. Apparently, the Mandan excelled at trading, at the expense of the Assiniboine (Meyer 1977:20). La Vérendrye lost the services of his interpreter when his Assiniboine traveling companions left, so much of his stay was not as productive as might be hoped today. Also, La Vérendrye himself did not venture from the first village during his stay. His lieutenants did visit other villages on the river, but since none of them kept journals, the loss to modern study is considerable. La Vérendrye brought trade goods with him, and traded these with the Mandan. His visit served to heighten interest among the village peoples in Euro-American trade goods, and to intensify the trading of them. Upon his departure, La Vérendrye presented the principal chief with a flag and a lead tablet to signify his having taken posession of their land for the King of France (Burpee 1927 in Bruner 1961:199). Other traders did not follow La Vérendrye from Canada until later in the century, but when they did come, they followed his pioneering route.

The location of the village visited by La Vérendrye is open to interpretation. Meyer (1977:21) believes it to be the Menoken site, located east of Bismarck. It is located on the upper reaches of the Apple Creek drainage, and is afforded some protection as part of the North Dakota State Park system. Smith (1980:91-92) believes that the case for Menoken is far from convincing. The site is much smaller than that described by La Vérendrye, and is generally not consistent with the description of the village visited in 1738. Until a systematic survey of the Apple Creek drainage is undertaken, the identification of the village visited by La Vérendrye will remain questionable.

Post-La Verendrye Contact

The La Vérendrye trip to the Mandans in 1738 was followed by two expeditions to them directed by his sons. The first returned to the Mandan villages for ten days in 1741. The second was directed by two of La Vérendrye's sons, and returned to the Missouri Valley in 1742. The expedition then explored to the south and west in a poorly documented series of wanderings which may have reached as far as the Big Horn Mountains (Wood and Thiessen 1985:22). It is certain that they reached Fort Pierre, South Dakota, since they buried a lead tablet on a hilltop near there. It was discovered in 1913 and has every indication of authenticity (Smith 1980:123-127). The lead tablet left with the Mandan in 1738 has never been located. trade with the Mandan and Hidatsa apparently languished after La Vérendrye's recall to eastern Canada. The years 1743-1785 are poorly understood from the standpoint of the fur trade (Wood and Thiessen 1985:26). Contacts were made during these years, but the level of activity was lower than that which developed after the mid-1780's.

The Canadian fur trade was disrupted by the French and Indian

War, which ended in 1763. After that time, English traders began to move into the area. These visits included one in 1773 by a trader named Mackintosh, who left a fragmentary record of his time in the Mandan villages (Meyer 1977:26-27). In 1781, Donald MacKay visited the Knife River villages. He was later the master of Brandon House for the Hudson's Bay Company and kept a detailed journal of his role there. Unfortunately, the record of his visit to the villages is unpublished (Wood and Thiessen 1985:25). A somewhat better documented trip to the villages was made in 1787 by James MacKay, who visited and traded with the Mandan for ten days (Wood and Thiessen 1985:26).

The upper Missouri and northern Plains passed through "ownership" of several competing European nations. For the most part, this passed unnoticed by the Mandan and Hidatsa. Their trade contacts continued to come overland from the northeast, so European territorial claims were of little concern. During the time of Spanish claim to sovereignty, the area was visited by a trader who left a written record of his experiences. John Evans, while in the employ of James MacKay, reached the villages at the mouth of the Knife River on September 23, 1796 (Wood and Thiessen 1985:28). He was acting as a representative for Spain, and attempted to assert Spanish authority over the villagers and their trading relationships. He confiscated a North West Company trading post, which was probably abandoned, and attempted to prevent the Mandan and Hidatsa from trading with the Canadians. He was not especially effective, as his visit did not substantialy deter traders from Canada (Wood and Thiessen 1985:28-29). Evans´ visit was, however, very significant in another regard. In the course of his journey, he produced a very detailed map of the Missouri River from Fort Charles near present-day Sioux City, Iowa to the mouth of the Knife River (Wood 1981). This map was a major resource for the subsequent Lewis and Clark expedition.

Evans´ visit to the Knife River villages and his claim of Spanish sovereignty brought up the question of who really controlled the upper Missouri and its lucrative trade. These questions prompted a journey to the Knife River by David Thompson, a geographer for the North West Company. He reached the villages at the mouth of the Knife River on December 30, 1797. He was the first explorer before Lewis and Clark to leave enough information of real usefulness in the determination of village location and tribal identity (Wood 1977:330). Many of his detailed observations have also been helpful in the reconstruction of village lifeways on the eve of American penetration of the area. The sections of Thompson´s journal describing his journey to the villages and his stay there have recently been edited and published in their entirety by Wood and Thiessen (1985:93-128).

In the early part of the nineteenth century, trading posts began to appear in the vicinity of the Mandan and Hidatsa villages. Prior to that time, contact with traders was limited to temporary visits from representatives of Canadian companies. Another factor, though, was the long presence of tenant or resident traders among the Mandan and Hidatsa. These men lived among the Indians, learned their language, and became very much like their hosts (Bruner 1961:214). Many took Indian wives and lived permanently among the Indians (Lehmer 1971:170). Most left no record of their presence, and are unknown today. One exception is Toussaint Charbonneau, who lived for many years in the middle Hidatsa village, now known as the Sakakawea site. His Shoshone wife, Sakakawea, was Lewis and Clark's guide from the Knife River villages to the Pacific coast. Charbonneau accompanied the expedition as well and it is primarily through Lewis and Clark's journals that he is known to us today. Tenant traders were major sources of information for explorers, and were contacts for trading companies. They probably traded goods such as horses, furs, food, and slave women to fur trading parties (Wood and Thiessen 1985:47). They also served as the only continuous, first-hand contact between the Indians and Euro-American traders prior to the early nineteenth century.

In the eighteenth century, disease became a major factor for the villagers of the upper Missouri. A major smallpox epidemic swept through the area in 1780. The epidemic was well documented, and was continent-wide in scope. It resulted in the decimation of Indian tribes all over North America, and altered the balance of power between Indians and Euro-Americans. In the upper Missouri, its effects were severe. It has been estimated that the Mandan, Hidatsa, and Arikara suffered population losses of 68% (Lehmer 1977b:107). The effect of this was to cause the abandonment of a large number of villages along the river. In 1804, Lewis and Clark found a total of eight inhabited villages, three Arikara, two Mandan, and three Hidatsa (Lehmer 1977b:107). The archaeological record shows that the valley was filled with villages prior to the advent of epidemic diseases. The smallpox virus traveled quickly across the continent from person to person to reach the upper Missouri. The well developed aboriginal trade system provided the vehicle for rapid disease transmission along the trade routes (Lehmer 1977b:106). The 1780 epidemic is well documented, but it may not have been the first. In 1795, Truteau related that the Arikara had suffered three previous epidemics, reducing them to their population at that time (Nasatir 1952I:299). This suggests that the earliest accounts of traders already reflect a greatly reduced population.

American Contact

The purchase of Louisiana in 1803 by the United States from France passed with little notice among the villages of the upper Missouri. Other European claims had come and gone with little effect, and this must have seemed like just one more. This purchase was, however, to be different. President Thomas Jefferson dispatched explorers Merriwether Lewis and William Clark to investigate America´s new acquisition and to report on their findings. Their expedition of 1804-06 was a major factor in the opening of the western frontier by the United States, then confined primarily to the eastern portion of the continent. Lewis and Clark made some of the first detailed observations of the frontier, and their journals have been the subject of scholarly inquiry for generations. The Lewis and Clark Journals have been published in a variety of formats since shortly after the expedition's return (Biddle 1814; Thwaites 1904-05; Quaife 1916; Gass 1958). This list of publications does not include the final, definitive work on the Lewis and Clark journals currently in preparation by Gary Moulton.

Lewis and Clark spent the winter of 1804-05 at Fort Mandan, which they constructed 5-6 miles downstream from the mouth of the Knife River. The McLean County Historical Society has built a reconstruction of the fort on the east bank of the Missouri River, but it is several miles downstream from the location of the original. In their winter at Fort Mandan, Lewis and Clark learned far more than any of their predecessors about the Mandan and Hidatsa (Meyer 1977:44). Their journals remain today as a major source for the intepretation of village location, tribal movements, lifeways, trade patterns, ceremonials, and material culture. When Lewis and Clark left Fort Mandan for the west coast, they took a Shoshone woman named Sakakawea as a guide. She and her husband, tenant trader Touissant Charbonneau, were returned to their home when the expedition passed the Knife River on its way back down the Missouri to St. Louis.

The Lewis and Clark expedition opened the water route from St. Louis to a flood of traders, many bound for the rich beaver waters of the Rockies. There was still some contact with Canadian traders, but the balance of power gradually shifted to American trading companies operating out of St. Louis. While Lewis and Clark were at the Knife River villages, a North West Company trading expedition arrived from Canada with Charles McKenzie and Francois-Antoine Larocque as members. Both McKenzie and Laroque kept detailed journals, which have been edited and published by Wood and Thiessen (1985:129-296). Another North West Company trading trip to the villages was made by Alexander Henry in 1806. He left a detailed journal which is of considerable use today, despite the dim view he took of the Indians. McKenzie and Henry represented a declining phase of the fur trade. The new pattern of many people moving up the river was established shortly after Lewis and Clark. Among the earliest was an expedition which came upriver in 1811, carrying John Bradbury and Henry-Marie Brackenridge, both of whom left journals. The Canadian fur trade was shortly to become a thing of the past.

Trading Posts

After the water route from St. Louis had been established by Lewis and Clark, a series of trading posts were constructed in the Knife River area to take advantage of the village trade. The early posts were transitory structures which did not last for any period of time. Among the first was a post established by Manuel Lisa, representing the American fur Company. It was constructed about 11 miles upstream from the Hidatsa villages in 1809 and was abandoned in 1812. No evidence of this post exists today, but the area is wooded bottoms, where repeated flooding would have obliterated any surface indications. Systematic subsurface coring would be necessary to determine if any evidence of the post remains. Joshua Pilcher constructed a short-lived trading post (Fort Vanderburgh) just above the Hidatsa villages in 1822 (Wood and Thiessen 1985:39-41). No surface evidence for it exists today. William P. Tilton also constructed a post at an unknown location downstream from the villages in 1823. It was abandoned in 1825 (Thwaites 1905-06, 23:223-228). None of these posts lasted any period of time, and it is unlikely that they seriously affected the Indians' middlemen trading position.

The Indians were seriously undercut in their trading operations by the construction of Fort Clark in 1830-31. It was a substantial one story log building located near the lower Mandan village. Its foundations are clearly visible today near the earthlodge depressions of the Mandan village. Both are preserved as part of the North Dakota State Parks system. Fort Clark was operated by the American fur Company for over 30 years, finally being abandoned in the closing days of the fur trade in 1861. The fort was a permanent fixture in the area, and was regularly supplied by company steamboats coming upriver from St. Louis.

Trade activities reached a peak in the 1830's, and Fort Clark was visited by many famous individuals who toured the area as guests of the fur company. George Catlin was in the area in 1832-33. He produced a long, romantic narrative of his experiences on the upper Missouri and other parts of the frontier, along with many paintings

(Catlin 1973). The quality of his paintings is uneven, but a great deal of information has been gleaned from them. Perhaps even better known is the expedition of Maximilian and Bodmer, which spent the winter of 1833-34 at Fort Clark. Prince Maximilian was a dedicated ethnographer, and he produced an extremely detailed journal. The expedition is probably best known for the watercolor paintings of his Swiss artist, Karl Bodmer. Bodmer's paintings are so meticulous as to resemble color photographs. This expedition gathered one of the last detailed pictures of the village tribes prior to the final smallpox epidemic and the beginnings of reservation life (Maximilian 1843; Thomas and Ronnefeldt 1979).

Disease

The fur trade system, and in many ways the Plains Village way of life came to an end in 1837. In that year, a devastating smallpox epidemic swept through the area, decimating the village tribes (Trimble 1979). The disease was carried on board the American Fur Company's steamboat "St Peters" on its yearly journey to supply the trading posts. Although smallpox was recognized on board when the boat was in Nebraska, the journey continued, carrying the disease throughout the Plains. The effect of the smallpox at Fort Clark was recounted in harrowing detail by Francis A. Chardon, the company agent in charge of the post. Mortality was extreme with the Mandan losing 90% of their population. The Arikara and Hidatsa were somewhat less affected, but they too were decimated. The remnants of the village tribes were forced into a handful of villages. The nomadic groups were not as affected by the disease, so they survived to become the "hostile" Indians of the late nineteenth century. In retrospect, the St. Peters should have turned back as soon as the disease was recognized on board. Nobody knew, however, how smallpox was transmitted, and in any case, the American Fur Company had nothing to gain by exterminating 17,000 customers (DeVoto 1947:296-297). The remnants of the village tribes held on for a time at Fort Clark and at Big Hidatsa, but by 1862, they had all gathered at Like-A-Fishhook Village, to begin reservation life.

Discussion

The Indirect trade Period began in the early 1600's. In the late 1600's, the number of trade items moving into the interior increased as the Hudson's Bay Company established trading posts on the shores of Hudson Bay. The Cree and Assiniboine became the only source of Euro-American goods for the Mandan and Hidatsa, who were then at the outer margins of the trade system. During this time, the quantities of trade goods reaching the Mandan and Hidatsa were relatively small. Some of these goods were surely traded with other groups from the south and west, but it is likely that many of the goods were retained for the villagers' own use. This period lasted through La Vérendrye's visit in 1738, despite its significance as the point of initial contact. Although La Vérendrye opened the route for later trade expeditions, it was some time before traders arrived in numbers. La Vérendrye commented on the intense level of trade between the Mandan and the Assiniboine. At this time, the Mandan were trading garden produce, as well as items of native manufacture such as skin clothing, obtained from their trading partners to the south and west.

The Middlemen Trade Period began in the 1750's. By the 1780's, Canadian traders were going to the Mandan and Hidatsa regularly with Euro-American goods. This pattern as well as the presence of tenant traders may have begun as early as 1750, but the documentation is scanty. As the Mandan and Hidatsa acquired Euro-American goods, they moved them on to their trading partners at a substantial markup. This fulfills Ray's (1978) definition of middlemen trade, except that the traders were in this case coming to the Indians. As the Euro-American goods moved into the existing trade system, they did not alter its basic structure. However, trade emphasis shifted from perishables to imperishables such as metal, buttons, cloth, awls, axes, knives, and kettles (Ewers 1968:28).

By the mid-1700's, the Mandan and Hidatsa found themselves in an enviable position between the advancing frontier of the horse, and that of the gun. As early as 1738, La Vérendrye saw many native items traded to the Assiniboine in return for guns and powder, as well as other items such as axes, kettles, and knives. The reason behind the dichotomy between horses and guns was the Spanish refusal to trade guns to the Indians. Their horses, however, ended up in the Indian trade system primarily by virtue of having been stolen from Spanish settlements by the southern Plains tribes. The British and French traders had no restrictions on the trading of guns, so firearms entered the Indian trade system to the north and east of the upper Missouri. The Mandan and Hidatsa villages thus became the location where the armed tribes of the northeast acquired horses and where the mounted tribes of the south and west acquired guns (Ewers 1955:13). Both horses and guns were highly desired commodities, and the Mandan and Hidatsa were in an ideal position to exploit that demand.

The Mandan and Hidatsa were adept at moving Euro-American trade goods into an old trade system. They were sharp traders, and reaped great prosperity from the trade and their role in it. The Middlemen trade Period lasted through the time of Lewis and Clark. It survived the first epidemics, although the villagers did suffer from their reduced numbers and the hostility of their increasingly mounted and armed nomadic neighbors. Lewis and Clark and those who followed them in the early nineteenth century commented on the vast quantities of trade goods passing through the villages. It is likely that the Middlemen Period lasted through the period of transitory trading posts, such as those established by Manuel Lisa and Joshua Pilcher. These forts were short-lived, and probably did not significantly undercut the Indians' trading position.

The period of Direct Trade unquestionably began with the construction of Fort Clark in 1830-31. The fort was a substantial, permanent structure, and of more importance, it was regularly supplied by the American fur Company's steamboats. The steamboats made possible the regular transport of trade goods by the ton. The journey from St. Louis was not without its considerable hazards, however, as evidenced by the 1865 wreck of the steamboat Bertrand at DeSoto Bend, Nebraska (Petsche 1974).

The local presence of the trading posts eliminated the Indians' lucrative middlemen trading role, and their prosperity vanished. There was still a demand for their garden produce, but their role as brokers in the trade system was gone. The presence of tremendous quantities of trade goods accelerated the process of dependence which had begun earlier. This period of decline for the villagers came to a crashing end in 1837 with an epidemic of smallpox. The villagers never really recovered from it, and moved to reservation life shortly thereafter.

Acculturation

Acculturation is a process of cultural change which occurs in in contact situations. A large number of acculturation studies were published in the literature from the 1930's until the early 1960's. Most acculturation studies centered on the changes brought about by contact between Euro-Americans and native societies. The studies reviewed by Herskovits (1938) are good examples. In those cases, and in others, drastic changes in native cultures after contact have been described. They include changes in material culture, social organization, residence patterns, and ceremonial life.

One of the earliest uses of the term acculturation was by Powell in 1880, followed by Boas a short time later (Herskovits

1938:3-4). The term was used rather loosely until the 1930´s, when an organized effort was launched to arrive at a consistent definition to guide future research. That definition was produced by the Social Science Research Council and is reproduced below (Redfield et al. 1936:149-150).

> Acculturation comprehends those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subseqent changes in the original cultural patterns of either or both groups.

After the definition was completed and published, those individuals involved in its formulation added another portion, designed to eliminate incorrect usage (Herskovits 1938:10).

> Under this definition, acculturation is to be distinguished from culture-change, of which it is but one aspect, and assimilation, which is at times a phase of acculturation. It is also to be differentiated from diffusion, which, while occurring in all instances of acculturation, is not only a phenomenon which frequently takes place without the occurrence of the types of contact between peoples specified in the definition above, but also constitutes only one aspect of the process of acculturation.

The 1936 definition and addition rules out many of the types of contact and culture change which had been ascribed to acculturation. It excludes learning or education within one´s own culture, situations where only a single aspect of culture is transmitted, and it does not specify the relative complexity of the cultures involved or make inferences regarding dominance (Herskovits 1938:10-11). However, the usual usage of acculturation in the literature implies inclusion of these aspects.

A series of results or end products of acculturation are presented in the 1936 definition. The most important is that of acceptance, whereby one group takes over much of the culture of the other through the acquiescence of members of the accepting group. The result is assimilation of not only the behavior patterns, but also the inner values of the foreign culture (Redfield et al. 1936:152).

By 1953, the results of numerous acculturation studies had been published. On the basis of those results, the Social Science Research Council undertook a revision of the 1936 acculturation definition. Acculturation was defined as culture change that is initiated by the conjunction of two or more autonomous cultural systems (Broom et al. 1954:974). The article goes on to discuss the properties of autonomous cultural systems during contact, the contact situation, the conjunctive relations established between cultural systems, and the cultural processes which occur during contact. One important conclusion is that assimilation is not necessarily an inevitable end product of acculturation, as stated in 1936. In many cases, complete assimilation never occurs. Instead, a situation referred to as stabilized pluralism is achieved, whereby cultural differences remain, and are institutionalized to serve the interests of both groups (Broom et al. 1954:990).

Many acculturation studies followed publication of the 1936 definition and the 1953 revisions. An extensive review of that literature is presented by Teske and Nelson (1974), in an effort to distinguish between acculturation and assimilation and to clarify the definitions of both. They define acculturation as a process by which a culture adapts to new conditions imposed as the result of contact with another culture. The following series of key points in the process of acculturation were derived (Teske and Nelson 1974:358). It is seen as both an individual and a group phenomenon, and it is bidirectional or reciprocal. Direct, first-hand contact is necessary and dominance of one culture over the other is a factor in determining the degree and direction of acculturation. Acculturation is not contingent on a change in values or reference group, and it is not necessary for either group to have a positive orientation toward the other.

Teske and Nelson (1974) define assimilation as a separate process in which one culture is accepted by and incorporated within another. It is dependent upon acculturation, but is not a phase or end product of acculturation. Like acculturation, assimilation requires direct, first hand contact and can be either an individual or group process. However, it is unidirectional, and involves both changes in values and reference group. It also requires internal cultural changes and out-group acceptance. An example of the differences between acculturation and assimilation can be found among the modern descendants of the Mandan, Hidatsa, and Arikara on the Fort Berthold Reservation. They are highly acculturated after more than three centuries of contact with Euro-American culture. However, they are not assimilated into modern North Dakota society since they are generally not accepted as equals by members of the dominant culture.

The question of dominance of one culture over another in an acculturative situation has been addressed in all the definitions presented above. As pointed out by Herskovits (1949:529), dominance does not imply that one group is higher or more advanced, but when one group is larger or more technologically advanced and can force changes in the other, it is referred to as dominant. This brings up Linton's (1940:501-502) concept of directed culture change. It occurs when modifications in the social environment make modifications in culture necessary for survival. Directed culture change is accomplished when one group interferes with another group's cultural elements and/or inhibits that group's existing patterns. The Euro-American fur traders can be described as dominant in their contacts with the villagers. This is especially true late in the fur trade period, after the construction of permanent posts such as Fort Clark.

Acculturation constitutes not only changes in ideas, but also changes in material culture. These material culture changes are what archaeologists detect in excavations. The modification of native items during contact has been described by Quimby and Spoehr (1951). They derived a series of categories of material culture change as the result of contact. These categories will be discussed with reference to the modified bone collections from the Knife River villages in a later section. To some extent, social changes can be inferred from material culture changes. Lauriston Sharpe's (1952) classic study of the introduction of steel axes into Yir Yoront

Australian aboriginal society shows the kinds of far-reaching changes that are possible through the introduction of a single seemingly insignificant technological item. The Yir Yoront case is unusual in that stone axes served such a crucial role in the maintenance of social structure. However, even in areas such as the upper Middle Missouri where items of material culture were not as crucial to social structure the introduction of new technology would surely have produced cultural changes. Therefore, an attempt will be made in later sections to infer cultural changes from modified bone assemblages in the Knife River villages.

In summary, it seems clear that acculturation was the process occuring during much of the interaction between the Knife River Hidatsa and Euro-American traders. Assimilation was not taking place, in that the Indians were denied access to positions of any status or meaning within Euro-American culture. During the Indirect Trade period, face to face contact between the Hidatsa and Euro-American traders was lacking. Therefore diffusion, or the transmission of cultural traits was probably the operative process. Even so, social change and disruption followed introduction of the new technology. The basis for inferring such changes and disruptions prior to face to face contact will be presented in a later chapter.

During the Middlemen Trade period, starting about 1740, direct face to face contact with Euro-American traders was established, at least intermittently. During this period, diffusion gave way to acculturation as the dominant process. Cultural change was a two-way process at this time, as required by the definitions of acculturation. However, given the dominant position of the Euro-Americans, most of the cultural changes occurred in Indian culture. This was especially true during the latter part of the fur trade period, when permanent posts were located in the area.

Mandan-Hidatsa Acculturation Sequence

A detailed discussion of Mandan culture history and acculturation has been presented by Bruner (1961). Although the work specifically describes the Mandan, the Hidatsa were so closely related that it is possible to attach many of the events to them as well. Bruner (1961:188) divides the sequence of Mandan acculturation into five periods, Small Village (1250-1500), Pre-Horse Coalescent (1500-1750), Fur Trade (1750-1862), Military-Agency (1862-1883), and Reservation (1883-1953). The following section will attempt to relate Bruner's description of acculturation during the fur trade with the previously described sequence of Indirect, Middlemen, and Direct Trade periods.

The Indirect Trade Period, which lasted from about 1600 until 1740, corresponds to the latter part of Bruner's Pre-Horse Coalescent Period (1500-1750). During this time, Euro-American traders were scarce, and were probably represented mainly by tenant traders. Diffusion, not acculturation, was the operative process of cultural change. The only well documented trading expedition was that of La Vérendrye in 1738. Bruner (1961:205) maintains that changes among the Mandan as a result of contact with Euro-Americans prior to 1750 were negligible. Guns and metal tools were interpreted as alternatives, not replacements for items of native manufacture. In addition, the horse was seen as an addition which did not alter the basic pattern of Mandan life. This is the traditional interpretation of early trait diffusion on the Plains, advocated not only by Bruner but also by numerous other researchers such as Ewers (1955). Evidence from the modified bone assemblages in the Knife River villages suggests that the early introduction of Euro-American technology through the fur trade did cause cultural changes and disruptions. Further discussion of this point will be presented in later chapters.

The Middlemen and Direct Trade periods correspond to Bruner's Fur Trade period, (1750-1862). During this period, the traditional economy of the Mandan collapsed as the power of the surrounding nomads grew. Native technology based on pottery, stone, and bone declined and was replaced by metal objects and other trade items (Bruner 1950:229). Also at this time, the villagers began to accept secular knowledge from the Euro-Americans, especially such things as medicine and blacksmithing. Villages were also being consolidated in the wake of smallpox epidemics and the resulting loss of population. With a smaller population, some clans were lost, but the clan structure was intact at the close of this period (Bruner 1950:229-230).

The post-fur trade period, after 1862, is divided into two segments, Military-Agency (1862-1883), and Reservation (1883-1953).

After 1862, all three river tribes, Mandan, Hidatsa, and Arikara were located at Like-A-Fishhook village. Major social changes began shortly thereafter. The distribution of annuities and gradual breakup of the community as the agents encouraged small farmsteads contributed to major disruptions. Allottment of the reservation in the 1880s led to the final breakup of the kinship and age-grade systems (Bruner 1961:233-270).

Some cultural elements were very resistant to change. The clan structure, for example, survives today on the Fort Berthold Reservation, albeit in a form altered from pre-contact times. The important point to be gathered from Bruner's discussion is that prior to occupation of Like-A-Fishhook village in 1845, much of the social and ceremonial structure of the village cultures was still intact. Major changes, such as loss of the age-grade structure and kinship system, followed breakup of the community, especially when the reservation was allotted. Major changes in material culture occurred in the Knife River Villages during the fur trade, but major social structure changes came later.

Summary

The Hidatsa and Mandan were exposed first to Euro-American objects, and later to new ideas. As was the case with other groups, they readily accepted items of material culture but were much slower to accept new ideas and concepts. Some of those ideas and concepts such as age-grade societies, clan structure, and matrilineal social organization survived until allottment of the reservation in the 1880s. Some of the clan structure survived and is still in place today on the Fort Berthold Reservation.

It would be all but impossible to derive the decline of the clan structure and age-grade societies from examination of bone tool assemblages. What can be derived is a picture of social disruption and developing economic dependence. The introduction of metal tools, starting in the Indirect Trade period, placed a new element into village society. As the tools were used, the need for native manufactured bone tools was reduced and eventually all but eliminated. Those specialists whose skills were necessary to make the tools were no longer needed, and could no longer provide a valuable service to the community. Established channels of authority and knowledge would have begun to break down as individuals acquired the new technology outside of traditional means, such as purchase from specialists. Those who acquired the new technology and the prestige which went with it might not have been those deemed worthy by the Hidatsa. The traders would have had a much different idea of good Indian qualities than would the Hidatsa leadership. Along with the social disruption came increasing economic dependence. As the villagers became dependent on the new technology, they also became dependent upon the traders for the items which they could no longer make for themselves.

The Indians perceived the traders as very powerful, and the traders attempted at all times to maintain that image (Saum 1965). The traders would have taken advantage of such a situation, and manipulated it to their advantage. This active involvement or manipulation caused social disruptions at a very early stage in the fur trade. A good example is that of the 17th and 18th century Kickapoo in what is now Wisconsin, and their interactions with the French (Silverberg 1957). Prior to actual contact, the Euro-American trade goods from French sources began to reach the Kickapoo. These goods were demonstrably superior to items of native manufacture, and so were in high demand. These highly coveted goods conferred prestige upon those who supplied them, the French in this case. This prestige preceded the actual arrival of French traders and meant that dominance in the contact situation was heavily weighted toward them, especially in the early stages of contact (Silverberg 1957:140).

The French made both deliberate and unwitting efforts to change Kickapoo culture. They attempted to alter Kickapoo marriage patterns so as to approach the European pattern of monogamy. They also influenced changes in warfare, away from the ritualized aboriginal pattern, toward the European pattern of serious attacks and territorial acquisition. This was often orchestrated so as to further French trading interests. French traders also mediated tribal disputes with the aim of preventing trade disruptions (Silverberg 1957:144-145). All of these activities caused major changes in Kickapoo culture.

Economic changes were also forced on the Kickapoo as a result of their involvement in the fur trade. Trade relationships with the

French broke down Kickapoo communal control over hunting, and replaced it with smaller hunting groups who had reached agreements with the traders. These groups rapidly hunted out the nearby fur bearing animals, and ranged farther into the interior. Their native implements were replaced with goods of European manufacture, requiring the acquisition of more furs to pay for what had become necessities (Silverberg 1957:149-150).

Another much more controversial explanation for the Indians' hunting out all the fur bearing animals has been offered by Martin (1978). Using the case of the eastern Algonkians, Martin portrays the decimation of animals as being related to disease and changes in Indian religious beliefs. A wave of epidemic diseases preceded the Europeans, and decimated the Algonkian populations. When their medicinal procedures could not cure the diseases, they believed it to be the result of betrayal of a long-standing relationship of mutual respect with the animals. In retaliation, the Indians hunted out the animals with a vengeance. Many researchers do not accept this scenario, but it does illustrate the potential for social disruption, well before actual contact between Europeans and Indians.

The contact interactions between Europeans and the Kickapoo and eastern Algonkians illustrates the roles played by fur traders. Not all of the processes described above may have occurred in the Knife River villages. The situation for the Kickapoo of Wisconsin and the Alkonkians of eastern Canada is obviously very different from that of the Knife River Hidatsa. However, disease was certainly a factor in cultural change. Also, the traders may have been carrying out some of the activities described above among the Hidatsa and their neighbors in the name of expanding trade opportunities. The point is that the traders were not passive providers of trinkets, and that social changes and disruptions accompanied their arrival, and almost certainly preceded them.

In the following chapters, the bone assemblages from the Knife River villages will be used to examine the development of economic dependence and associated social disruption during the Indirect, Middlemen, and Direct trade periods. Ultimately, an attempt will be made to develop a model of modified bone assemblage structure which can be used to predict the level of acculturation in archaeological situations where documentation is not as complete as it is here.

FIELD AND LABORATORY METHODOLOGY

Research at the three villages within the Knife River Indian Villages National Historic Site (KNRI) was conducted as part of the Knife River Archaeological Project. The project was the result of a cooperative, long-term agreement between the National Park Service and the University of North Dakota. Research in the area was set in motion by the 1974 Congressional authorization to purchase Lower Hidatsa, Sakakawea, and Big Hidatsa villages along with intervening properties. Tracts within what was to become the KNRI were purchased separately from individual land owners, over considerable local opposition. In 1976, the Sakakawea site was purchased and the National Park Service Midwest Archeological Center began salvage excavations and cutbank profiling. In 1977, the National Park Service and the University of North Dakota continued test excavations and cutbank profiling at Sakakawea as a joint field school. In that same year, Dr. Stanley A. Ahler was hired at the University of North Dakota to direct a program of long-term investigations in the KNRI. All subsequent work was guided by a comprehensive research design (Ahler 1978). The following section will describe the research design and how it guided field and laboratory methodology at the three major villages.

Research Design

The 1978 research design envisioned a three phase, twelve year project, with the latter phases building upon previously gathered information. At the end of Phase III, it was expected that a comprehensive understanding of the complex cultural interactions in the KNRI area would be reached. This information was then to be used by the National Park Service in the development of a detailed interpretive program for KNRI visitors. Ultimately, the National Park Service chose not to fund the project beyond Phase I as described in the research design, citing funding constraints and the belief that sufficient information had been gathered for interpretive purposes.

Phase I

Phase I was the initial stage of data gathering. It consisted of efforts aimed at locating and identifying all cultural resources in the KNRI, while collecting baseline data to be used in the later phases of research (Ahler 1978:40). Phase I contained a variety of sub-projects and analyses which will be described below.

Intensive mapping and remote sensing of the KNRI was a major Phase I priority. Initially, detailed 0.5 foot interval contour maps of each major village were prepared from aerial photographs by the National Park Service Chaco Center in Albuquerque. The resulting maps were of great assistance in proton magnetometer survey, intensive surface collection, and problem oriented test excavations. These maps were the source for Figures 3 and 4. Another early goal was the production of detailed contour maps of the entire KNRI, to be used in surface reconnaissance. Aerial photography was completed in 1978, resulting in the production of 22 metric base maps. All cultural resource locations have been plotted on these maps, and a detailed description of those resources and procedures employed to locate them may be found in Lovick and Ahler (1982). The metric base maps provided the source for the contour map of Big Hidatsa village, reproduced here as Figure 6.

Complete inventory of the cultural resources in the KNRI was a goal of Phase I. Using the metric base maps described above as a control, a variety of survey techniques were employed to investigate all areas of the KNRI. These techniques included traditional pedestrian survey, and power auger transects in flood plain areas with limited surface visibility. In large cultivated tracts, point-quarter survey techniques were employed, and the resulting artifact density maps were plotted using computer-assisted graphics packages. This technique was also used in pastures with limited surface visibility. A complete description of the point-quarter technique as applied in the KNRI can be found in Ahler et al. (1979b). The final results of the surface inventory are presented by Lovick and Ahler (1982), and the generalized map of all KNRI cultural resources is reproduced here (Fig. 2). Note the extremely high density and diversity of cultural resources in the park. The three main villages were the reason for National Park Service purchase, but they are only a small portion of the total resource base.

Proton magnetometer survey is a technique by which slight differences in subsurface magnetic potential can be detected with sophisticated instrumentation. Cultural features, especially those

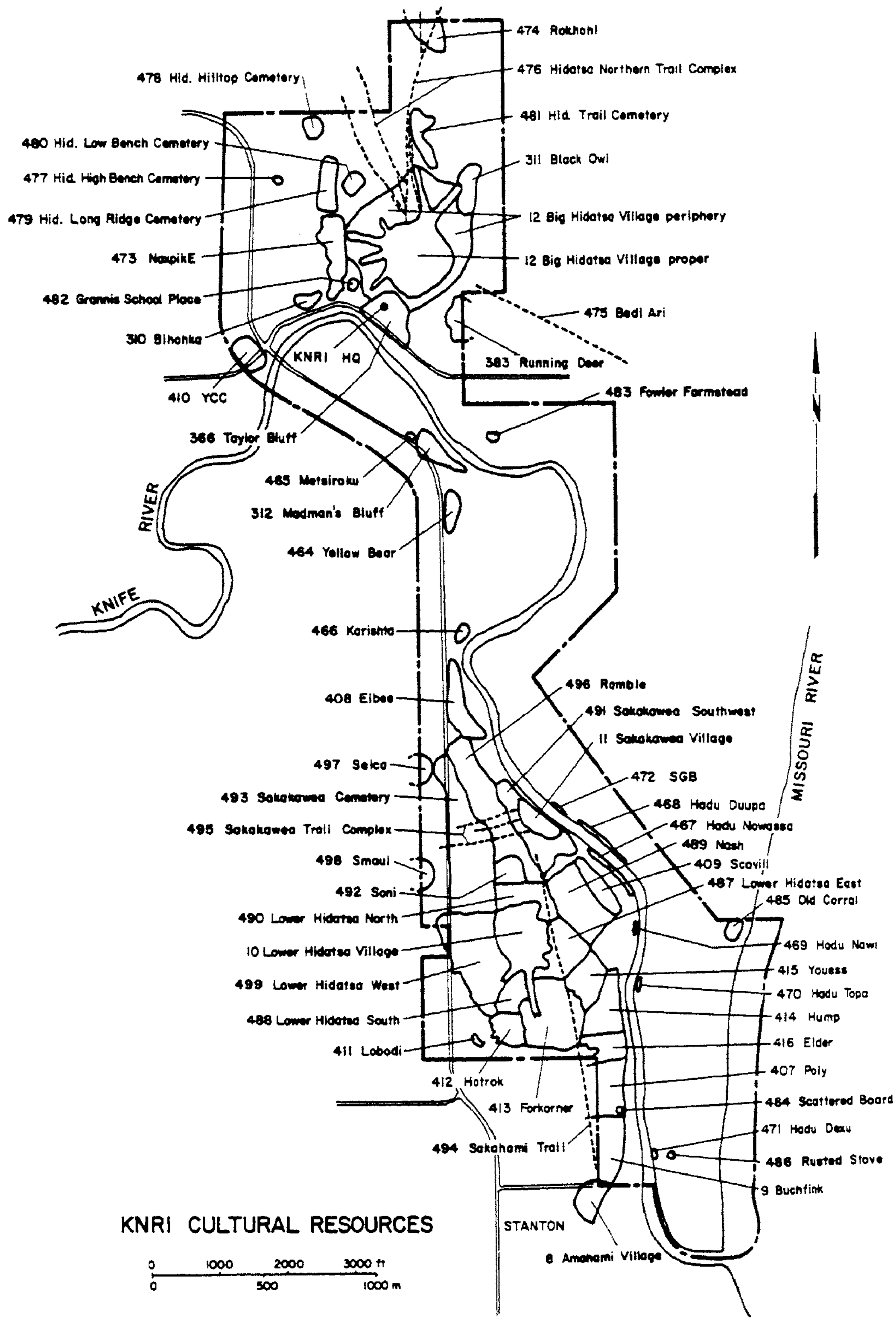


Figure 2. Location of all archaeological and historic sites discovered during Phase I inventory of the KNRI (Lovick and Ahler 1982:8 Fig. 1).

containing burned earth, such as fire hearths, have a significantly different magnetic potential from the surrounding soil matrix. These differences can be mapped using computer graphics, providing a subsurface map of cultural features without the necessity for excavation. This non-destructive aspect of proton magnetometer survey, and its potential for guiding test excavations, made the technique a major aspect of Phase I research (Ahler 1978:42-43). Proton magnetometer survey was conducted at all three villages, and at other locations within the park. It provided detailed information regarding subsurface features, especially within earthlodge depressions (Weymouth and Nickel 1977; Weymouth 1979).

Environmental and paleoenvironmental studies were also part of Phase I research. Environmental change has been cited as a possible cause of significant changes in aboriginal settlement patterns within the Middle Missouri (Lehmer 1970). Given that importance, environmental studies were identified in the research design and pursued as part of Phase I research (Ahler 1978:46-47). The primary result of this research emphasis was the production of a detailed study of geomorhpological change and landform evolution in the KNRI area (Reiten 1983).

Problem oriented test excavations were conducted at all three major villages as well as a number of other, smaller sites. The excavation program was a major focus of Phase I research, and occupied a large portion of field and laboratory effort. A series of goals for the test excavation program were developed in the research design (Ahler 1978:44). They were to: (1) determine cultural debris density, (2) test recovery procedures and associated logistics, (3) explore site stratigraphy and gather controlled samples for chronological control, (4) determine the presence or absence of human burials, (5) confirm anomalies detected in aerial photographs and proton magnetometer survey, and (6) delineate the nature of subsurface cultural components. Test excavations were undertaken at Sakakawea (Ahler et al. 1980), Lower Hidatsa (Ahler and Weston 1981), Big Hidatsa (Ahler and Swenson 1985), Elbee (Ahler 1984), and numerous smaller sites within the park (Ahler and Mehrer 1984).

Phase II

Phase II of the research design was intended to be a four year period of intensive and extensive excavation and analysis (Ahler 1978:50). One objective was to collect controlled samples of artifactual material which could be used by the National Park Service for interpretive programs. At the end of Phase II, it was hoped that a series of broad research questions would be answered. These included (1) which tribal groups had occupied which villages and why they were abandoned, (2) the interrelationship of material culture of the Hidatsa subgroups and the Mandan, and (3) identification of special activity areas such as butchering locales, and burial areas (Ahler 1978:50).

Phase III

Phase III was to be a five year period of major excavations, continuing analysis, and living archaeology (Ahler 1978:54-55). Major investigations were to include excavation of one complete dwelling and an associated activity area in each village. Such excavations would be carried out in sites representing each of the major taxonomic divisions within the KNRI. Other major investigations were to include excavation of large spatial expanses within the villages. The small excavation units of the earlier research phases were designed to provide the background information for large-scale excavations in this phase. The living archaeology program was to have included the construction of replica earthlodges at off-site locations within the park. These replicas were to contain displays of village material culture functioning as it would have in aboriginal society. The National Park Service interpretive program was to be implemented at this time, given the detailed level of knowledge concerning cultural interactions within the park (Ahler 1978:54-55).

Major Research Themes and Questions

Three major emphases and research questions were identified for study in the original research design (Ahler 1978:35). First was the development of inter-village and intra-village chronological control. Second was the establishment of ethnic identity for the groups inhabiting each village, and an attempt to compare and contrast Mandan and Hidata culture histories. Third was the definition and analysis of the evolution of cultural subsystems through time, such as technology, trade, ceremonial, and settlement (Ahler 1978:35). These research goals were all addressed to some degree, although not to the extent originally hoped for, given the project's end after Phase I.

The present study falls under the third major research topic identified above. Specifically, the research design posed the question of how rapidly the native stone and bone technology was replaced and whether or not there was a sequential replacement of native tools with Euro-American substitutes. It questioned whether or not regularities could be recognized in this process which might operate in other contact situations (Ahler 1978:37). The present study focuses on modified bone, to the exclusion of stone technology. With that exception, the research questions posed in the original research design constitute the main thrust of this study.

This study, and others in the Knife River project, can go considerably beyond the understanding of the village cultures attainable from ethnographic sources alone. This was pointed out in the research design as justification for the time and expense of KNRI archaeological investigations.

Excavation Unit Placement

Problem oriented test excavations were conducted at all three major villages. At each site, a series of 1 x 2m excavation units were placed, their number dictated by field resources. They were excavated with a small field crew, under the terms of the research design outlined above.

All three of the villages are very large and contain complex internal stratigraphy. The usual strategy for excavation unit placement in a large, complex site would be to employ some sort of random sampling strategy. This is done in order to overcome any bias introduced by the investigator and to produce random samples of cultural materials and stratigraphic information which can be used to infer content in the rest of the site (Mueller 1975). In the case of the Knife River Villages, Phase I research goals could best be achieved through judgemental placement of excavation units. This strategy allowed placement of test units in specific areas of stratigraphic interest, and allowed avoidance of areas with little stratigraphic value, such as house walls, central fire hearths, and pot hunter pits. It also allowed placement of test units so as to investigate anomalies detected on aerial photos as well as during proton magnetometer survey. Such non-random placement of test units suggests that conclusions regarding changes in stratigraphy and material culture cannot be applied to the sites as a whole, due to bias in unit location. This is not, however, viewed as a serious problem, due to the overriding problem of small sample size. All three of the Knife River villages are enormous, and a small number of 1 x 2m excavation units cannot by any means be considered a statistically significant sample. Random placement of excavation units would have been statisticallly preferable, but the sample size would still have been infintesimally small, and the research value of the units would have been greatly lessened.

Lower Hidatsa Excavations

National Park Service/University of North Dakota investigations at Lower Hidatsa village began in 1977 (Ahler and Weston 1981:25). An arbitrary 20m interval grid, oriented toward magnetic north was established providing baseline control for all subsequent investigations. The first investigation consisted of intensive surface collection of all cultural materials within four 20 x 20m blocks (Ahler and Benz 1980). Also in that summer, a proton magnetometer survey was conducted in six 20 x 20m blocks, and a detailed map of the resulting magnetic anomalies was prepared (Weymouth 1979). This information was used as an aid in placement of excavation units during the following summer.

In 1978, problem oriented test excavations began at the site with placement of five 1 x 2m excavation units (Ahler and Weston 1981:26-27). They obviously represent a tiny sample when compared with the immense size of the village (Fig. 3). In analyses, the excavation units were referred to as archaeological context units, or AC units. Not shown in Figure 3 are two excavation units placed in the site by Donald J. Lehmer in 1965. His units were located in the southern portion of the site near AC unit 1, at unknown locations (Fig. 3). The site was also tested in 1938 by a crew from Columbia University under the direction of W. Duncan Strong (Strong

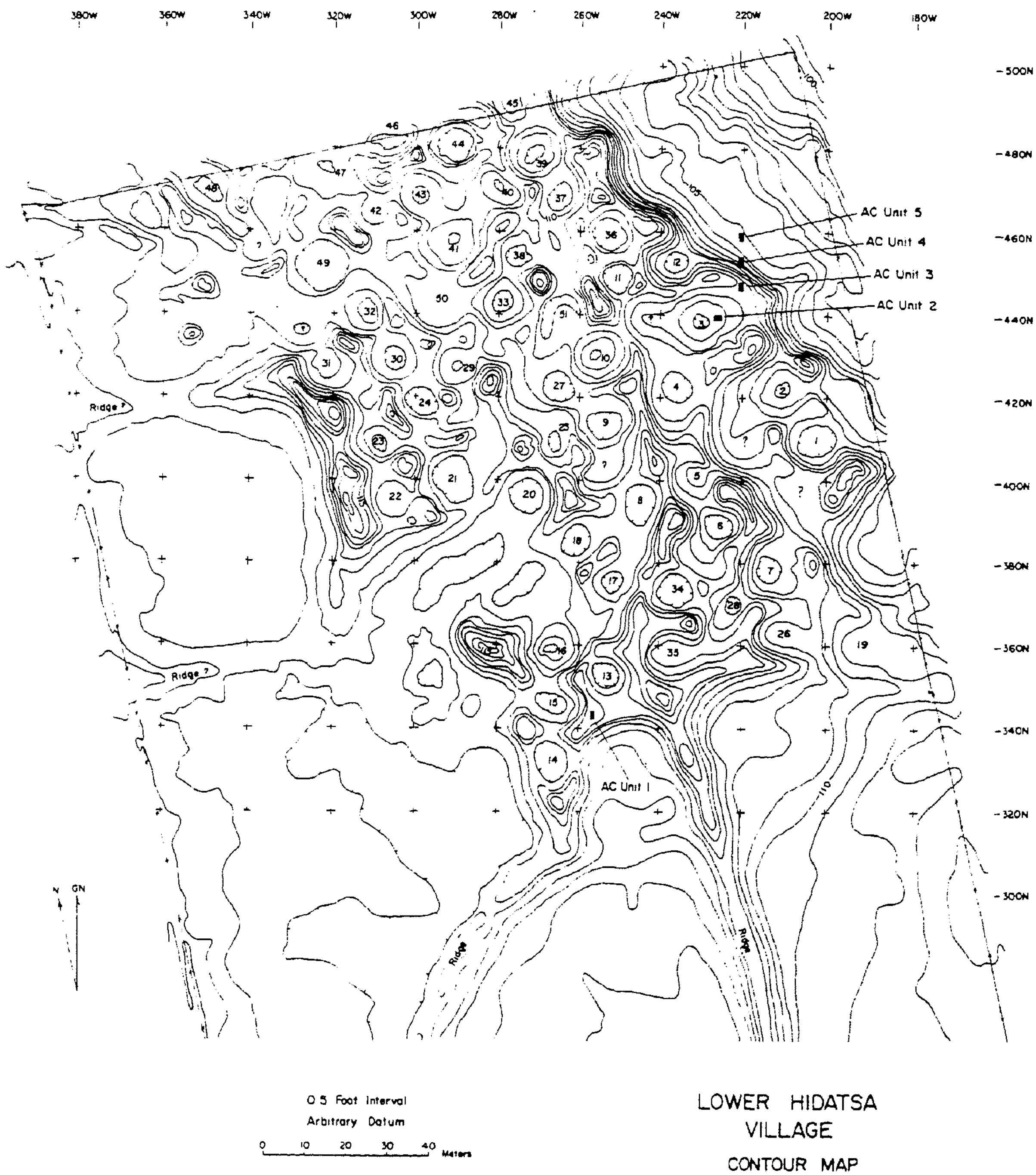


Figure 3. Contour map of the Lower Hidatsa Village (32ME10), showing locations of excavation units (AC units), and house depressions (Ahler and Weston 1981:22 Fig. 2).

1940). The location of those tests is also unknown.

As was the case at other sites in the KNRI, the AC units were placed with a transit-level and steel tapes and identified by the coordinates of their southeast corner (Ahler and Weston 1981:26-27). AC unit 1 was located in the southern portion of the site, near houses 13, 14, and 15 (Fig. 3). It was placed between houses, in an area of low magnetic activity in an effort to contrast with the other units located at the northern margin of the site. AC unit 3 was located inside house 3, in an area of low magnetic activity, away from the central hearth and wall areas, which would have yielded minimal stratigraphic information (Fig. 3). AC units 3, 4, and 5 were all located at the northern margin of the site, so as to cross the abrupt margin of the midden, where a 1.2m change in elevation is present (Fig. 3). AC unit 3 was located on a high midden heap, in an area of strong magnetic activity and no evidence of recent disturbance. AC unit 4 was located on the midden slope, while AC unit 5 was located in a level area off the site (Fig. 3).

Sakakawea Excavations

Investigations were conducted at Sakakawea village in 1976 and 1977, beginning shortly after National Park Service purchase (Ahler et al. 1980:50). The site is located at the margin of the Knife River and is bisected by a cutbank which was actively eroding at the time of excavations. As is the pattern at other Middle Missouri sites, the Sakakawea erosion progressed as large blocks of site matrix were undermined by the river, becoming detatched from the cutbank. Eventually, they fell into the water and were carried downstream. It is likely that half of the site eroded into the river in this manner prior to 1979 when an erosion-resistant berm was constructed at the base of the cutbank.

In 1976, fieldwork was directed by Robert K. Nickel of the National Park Service Midwest Archeological Center (Ahler et al. 1980:50). Excavation effort was confined to the cutbank margin of house 28 in the southeast portion of the site (Fig. 4). In that area, excavation effort was concentrated on salvaging those slump blocks which had cracked away from the cutbank and were on the verge of falling into the river. Excavation units were thus irregular, depending upon the shape and size of the slump blocks. The excavation crew worked along the margin of house 28, salvaging slump blocks as far as one of Lehmer's 1965 excavation units (Fig. 5). Lehmer excavated that unit, and one other in the northern portion of the site, during the same summer that Lower Hidatsa was being tested. W. Duncan Strong's 1938 field crew from Columbia University placed four test trenches in the site (Strong 1940). As is the case with Lehmer's second excavation unit, Strong's trenches cannot be located today (Ahler et al. 1980:19).

Also in 1976, profiling of the eroding cutbank at Sakakawea was begun. Profiling allowed salvage of information being lost to erosion, and represented a unique opportunity to completely cross section an earthlodge village. It was hoped that details of internal site stratigraphy beyond those available from isolated test

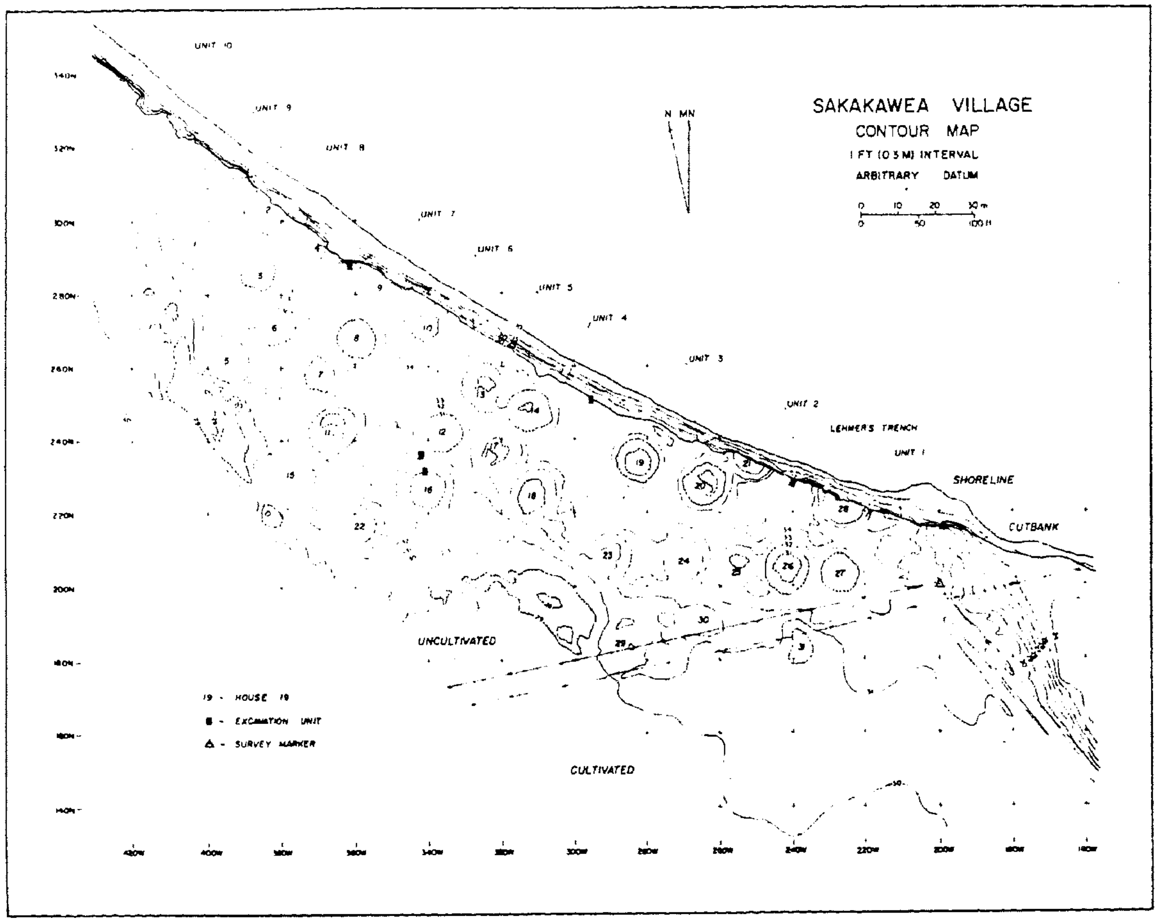


Figure 4. Contour map of the Sakakawea Village (32ME11), showing house depressions, cutbank profile units, and locations of excavations (Ahler et al. 1980:18 Fig. 2).

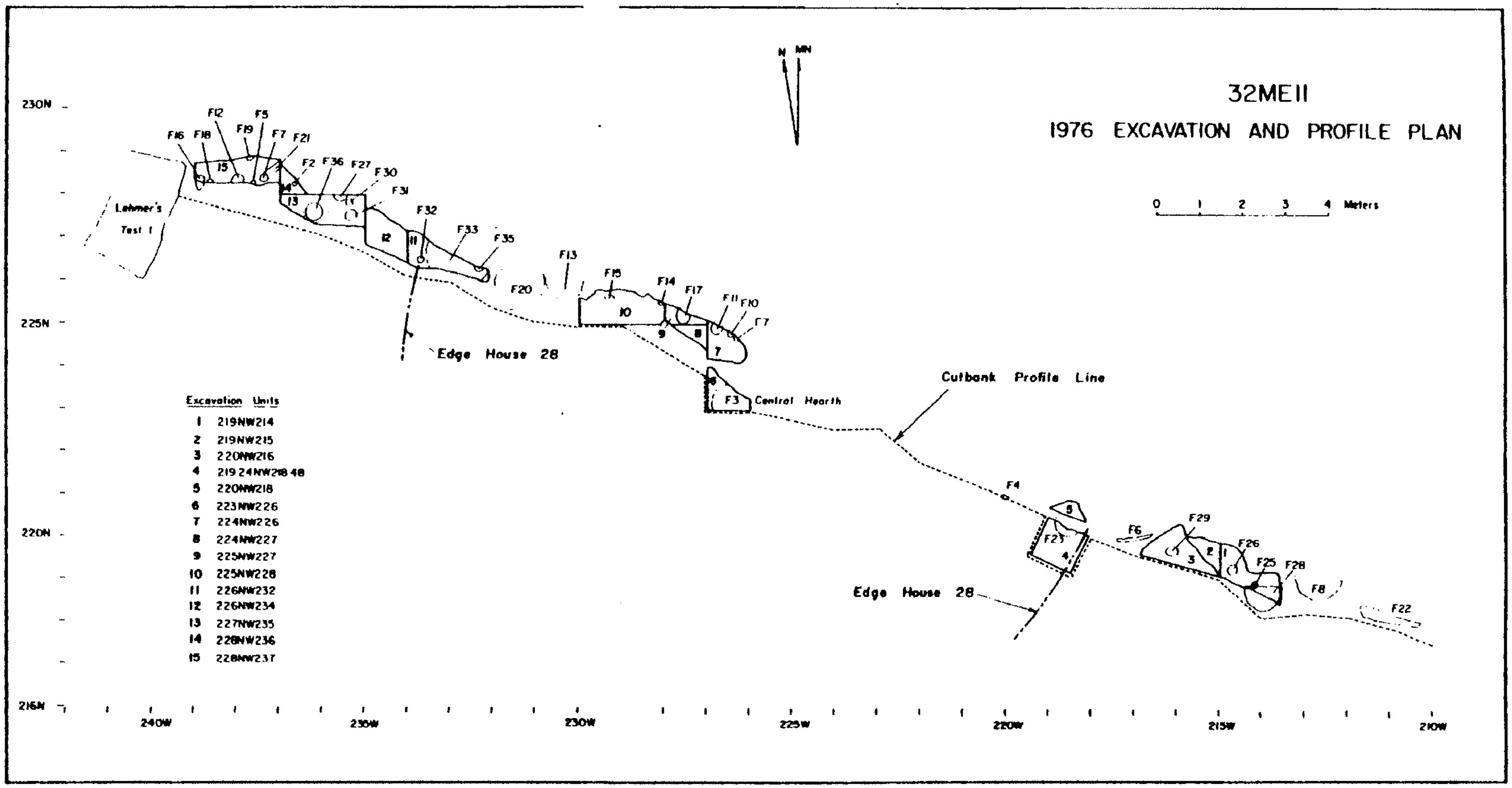


Figure 5. Locations of 1976 excavation units along the cutbank margin of house 28 at Sakakawea village (Ahler et al. 1980:51 Fig. 8).

units would be provided by the profiling project. Profiling was begun in 1976 along with salvage of slump blocks. It continued through the 1977 season and was completed in 1978 (Ahler et al. 1980:50).

In 1977, investigations continued at Sakakawea in the form of a joint National Park Service-University of North Dakota field school under the direction of Robert K. Nickel and Stanley A. Ahler (Ahler et al. 1980:53). Proton magnetometer information was available, so excavation emphasis was shifted to test magnetic anomalies in the central portion of the site. Four 1 x 2m test units were excavated in 1977. Two were located at the cutbank edge, one east of house 14 and the other between houses 4 and 9 (Fig. 4). The other units were associated with house 16. One was located inside the house over a low magnetic reading, while the other was located outside the house over a distinct magnetic high (Fig. 4). The magnetic low within the house was associated with a pair of basin shaped pits filled with burned stone while the outside-house magnetic high was assocated with a large hearth, and a deeply buried layer of burned earth (Ahler et al. 1980:53-54).

The 1976 and 1977 Sakakawea excavations were conducted prior to completion of the comprehensive project research design (Ahler 1978). However, the excavation goals and test unit placements were generally compatible with Phase I research objectives and the materials recovered from the excavations can be compared with those from other KNRI sites.

Big Hidatsa Excavations

Big Hidatsa is the largest of the three villages, and is certainly the best preserved, due to the long-term efforts of conscientious landowners who prevented relic hunters and other vandals from digging in the site. Test excavations were conducted at the site in 1980. By that time, it was apparent that the project would end after Phase I of the research design. More intensive investigations were thus undertaken with the knowledge that no further work was planned for the site.

Examination of the contour map revealed several distinct subareas within the site (Fig. 6). The core area, in the central part of the village, contains at least 69 house depressions with most being at least 1m in depth. The ground surface is relatively level between the houses, consisting of very deep laminated midden deposits (Ahler and Swenson 1985:11).

A distinct peripheral area surrounds the core on three sides, with the terrace margin making up the southern edge (Fig. 6). This peripheral area is more heavily vegetated and has house depressions which are shallower than those in the core. It also contains large depressed areas, which have been interpreted as borrow pits (Ahler and Swenson 1985:11). This area has been divided into three sections, eastern, northern, and western (Fig. 6).

Two other marginal areas surround the peripheral area (Ahler and Swenson 1985:20). The eastern margin is separated from the eastern periphery by a deep borrow trench, and is bordered on the

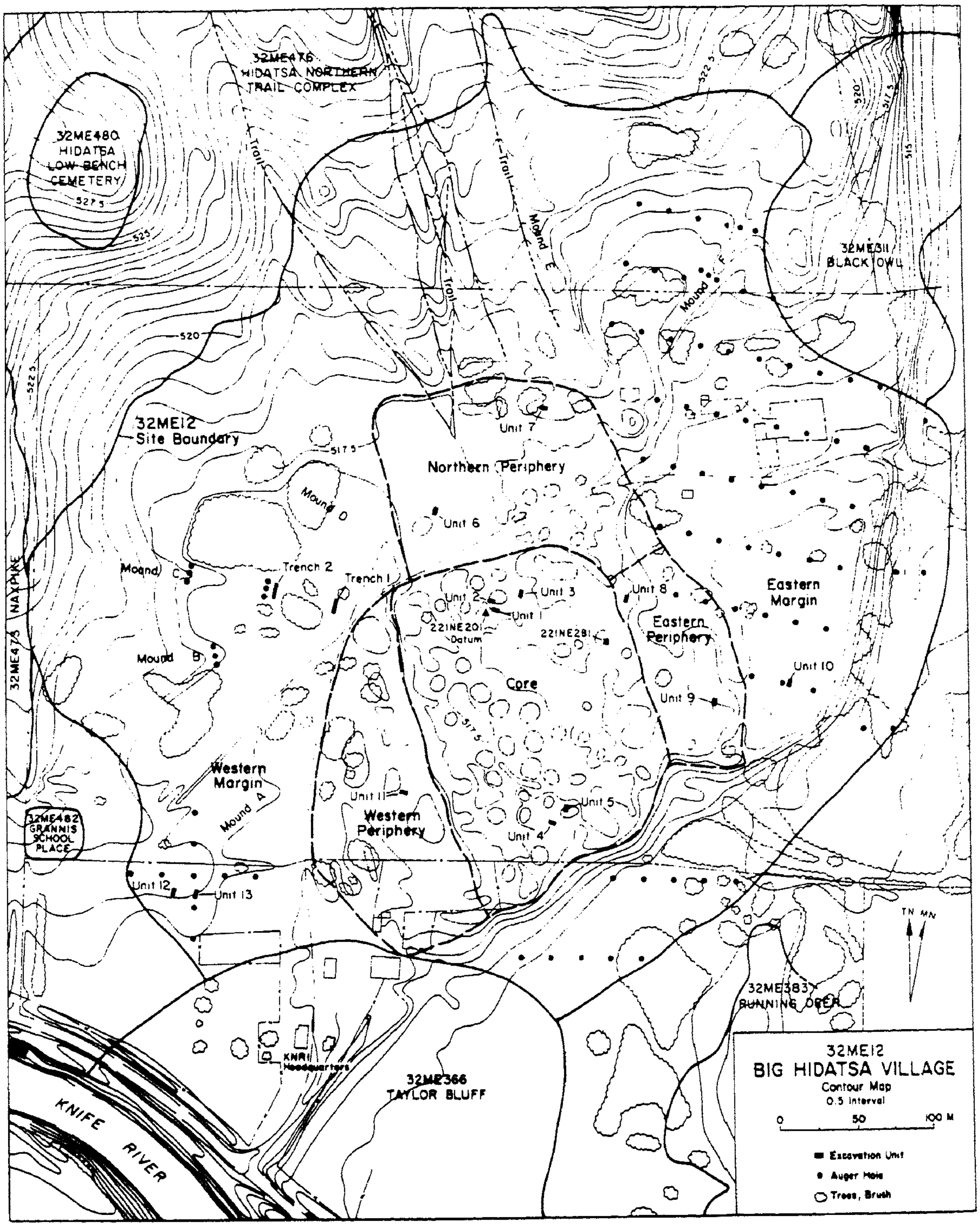


Figure 6. Contour map of the Big Hidatsa Village (32ME12), showing site subareas, excavation unit locations, and nearby sites and features (Ahler and Swenson 1985:24 Fig. 12).

east by the terrace edge (Fig. 6). This area exhibits a generally irregular ground surface with no definable house depressions. The western margin consists of a concentration of cultural debris on a natural elevation, west of the western periphery (Fig. 6). In total, the site contains 113 house depressions, with the core area exhibiting the highest elevation and all indications of the greatest intensity and duration of occupation.

A number of other special function features are visible on the contour map and on the ground. There are two poorly defined segments of fortification ditch, located at the edge of the western periphery, ending at an east-west fence line (Fig. 6). In addition, there are six linear mounds designated as A-F radiating out from the village (Fig. 6). They may have functioned as trails, since the 1980 excavations revealed them to be accumulations of artificial fill and cultural debris (Ahler and Swenson 1985:21-22).

A total of 13 1 x 2m excavation units were judgementally placed in the site to sample all areas described above and to investigate anomalies discovered during proton magnetometer survey. Excavation unit placement is illustrated in Figure 7 with reference to site subareas, excluding all other information.

Excavation Methodology

Excavation methodology was similar at all three villages, in an effort to assure consistency in data recovery (Ahler et al. 1980:49-52; Ahler and Weston 1981:26-29; Ahler and Swenson 1985:42-44). In all 1 x 2m excavation units, the following procedures were followed.

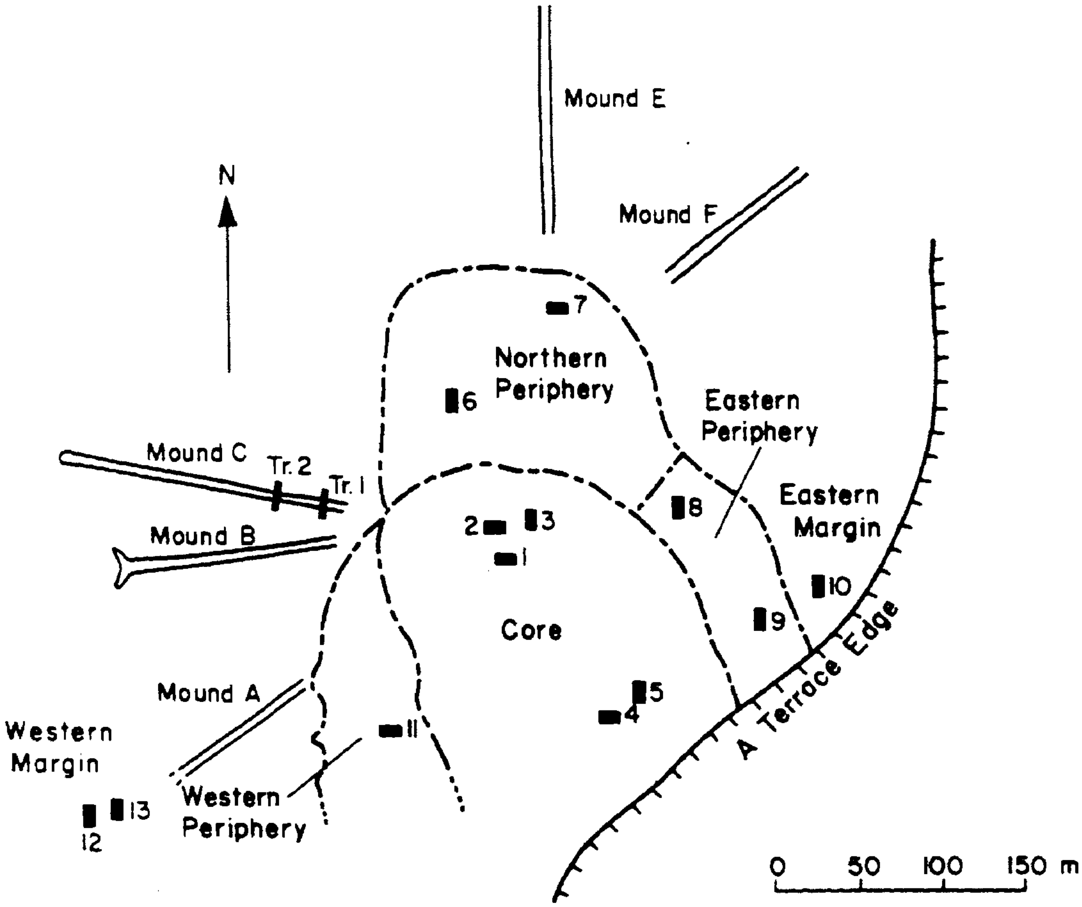


Figure 7. Schematic map of Big Hidatsa village showing site subareas and excavation unit locations (Ahler and Swenson 1985:263 Fig. 58).

Excavation was conducted with sharpened shovels and trowels, following the natural stratigraphy wherever possible. When none could be defined, the matrix was removed in 15cm arbitrary levels, numbered sequentially from the ground surface. Depths were measured from the ground surface, which was fairly level in most cases. An exception was made for units on steep slopes, where the southwest corner was used as a reference point. The unit was then removed in horizontal planes, established with a line level. Piece plotting of individual artifacts was kept to a minimum, as little could be learned from artifact distribution in a 1 x 2m test pit. This decision was also prompted by the very large quantity of artifacts, and concerns for field time. The low level of piece plotting was consistent with Phase I goals as outlined in the research design.

Cultural features were isolated from the surrounding matrix as soon as they were detected. All features, such as cache pits, post molds, and hearths were numbered sequentially for each site. They were removed in natural levels if possible. If natural stratigraphy could not be defined, especially in large pits, the fill was removed in 15cm arbitrary levels.

Documentation was also consistent among the three sites. A standard excavation form was filled out for each level in each excavation unit, each feature, and each level within each feature. A map was drawn at the completion of each level, showing artifacts in the floor, stratigraphic changes, and features. Small soil samples were taken in sterile bags from each separate cataloged unit. Black and white photographs as well as color slides were taken at frequent intervals during excavations.

In all subsequent analyses, a distinction was made between general level and feature samples. General levels were arbitrary or natural levels within an excavation unit. Features were cache pits, natural or arbitrary levels within pits, and other features such as post molds and hearths.

As was the case with other types of documentation, the cataloging system was identical for all three sites, so as to ensure comparability of results. Each site had its own sequential numbering system, starting with one (1). A unique number was assigned to each sample of material. This included each arbitrary or natural level within an excavation unit or feature. It also included each individually located artifact and each sample, such as soil samples. The system provides for a single numbering sequence for each site. There was no overlap with any other numbering system, greatly reducing the chance for error.

In most cases, excavation units were terminated at contact with sterile sediments. The exceptions were those units where excavations were continued into apparently sterile sediments beneath the village deposits, in the hope of locating pre-village cultural materials. When the decision was made to terminate an excavation unit, profile maps were drawn of all four walls. They were drawn to the same scale, and labelled in identical manner in an effort to make the results consistent and usable for each village. The profile maps recorded all features and stratigraphic changes, such as ash lenses, as well as all artifacts in the walls. A final step was to photograph all four walls in black and white and color. The resulting maps and photographs were of considerable use in assigning village components, which will be discussed below.

Recovery Procedures

Previous investigations in the Middle Missouri were primarily salvage oriented, as work was conducted in advance of reservoir construction. Faced with extreme time pressure, River Basin Surveys field crews often made use of heavy equipment, and made little use of time consuming procedures such as screening (Lehmer 1971:14). The intent was to salvage as much information as possible, and to concentrate on broad architectural trends obtainable from large-scale excavations. In the absence of consistent recovery procedures, there are limitations to conclusions which can be drawn from such artifactual data.

For the goals set forth in Phase I of the research design, consistent, near-total recovery was required. A pressurized water-screen system was used to achieve those goals. All fill from the excavations was washed over 1/16 inch mesh window screen. Galvanized window screen was placed in the bottoms of wooden boxes, and backed with 1/4 inch hardware cloth for reinforcement. A high pressure stream of water is required for this system, and it was provided by a 5 hp centrifugal pump. At all three sites, the waterscreens were located near the Knife River, being the nearest permanent water source. The associated logistics of moving fill to the river for screening were easiest at Sakakawea, which is on the river bank. Both Lower Hidatsa and Big Hidatsa lie at some distance from the river, making logistics somewhat more difficult. The solution was to haul wheelbarrow loads of site matrix in the back of a pickup truck to the river for screening.

As excavations proceeded, site matrix was loaded into wheelbarrows. All relevant catalog information was written on a laundry tag with indelible ink, and included with each wheebarrow load. The site matrix was hauled to the waterscreens, dumped in the screen boxes, and washed until the dirt was gone, and all cultural materials were clean. The cultural materials were dried on canvas cots, placed in labelled bags, boxed, and shipped to Grand Forks for processing and analysis.

Recovery of cultural materials using this system is virtually complete. Some materials will pass through the screens, including the smallest trade beads and Chenopodia seeds. The soil samples taken from each catalog unit were intended to make up for this shortcoming in the recovery system. Waterscreening produces very large quantities of cultural materials for analysis when employed at Plains Village sites with extremely high densities of debris. The five excavation units at Lower Hidatsa alone produced 79 1.25 cubic foot boxes of debris for analysis (Ahler and Weston 1981:55). Aside from consistent recovery, waterscreening can be a major labor saving device. This was demonstrated at major block excavations such as White Buffalo Robe (Lee 1980) and the Mondrian Tree site (Toom and

Gregg 1983). At these sites, artificial ponds were created as water sources, and small waterscreen crews were able to keep up with large block excavation crews.

Laboratory Analysis

Analysis procedures at the University of North Dakota in Grand Forks were geared toward consistent processing of very large quantities of cultural materials. Materials moved through a highly structured processing and analysis system from the time they were unpacked, to the production of final reports. Identical analysis procedures were followed for materials from all three sites in order to assure comparability of results. The procedures will be briefly described below.

Size Grading

Size grading was the first step in analysis when the waterscreen debris from the field was unpacked. This technique was used at all three major villages in the KNRI as well as many other sites in the Middle Missouri such as Lower Grand (Ahler 1975), Jake White Bull (Ahler 1977), Elbee (Ahler 1984), White Buffalo Robe (Lee 1980), and the Tree Site (Toom and Gregg 1983).

Size grading serves several purposes. It segregates very large samples into consistent categories of uniform size, providing an indication of relative degree of debris fragmentation as well as facilitating later sorting procedures. Size grading also provides consistent, arbitrary cutoff points for materials too small to be of use in analysis.

All cultural materials were passed through a series of nested U.S. Standard Sieve Cloth screens. Table 3 illustrates the size grade designations and associated opening sizes.

Table 3. Size grade designations and associated U.S. Standard Seive Cloth openings. (Ahler and Swenson 1985:69)

Size Grade	Abbreviation	Opening Size (English)	Opening Size (Metric)
Grade 1	G1	1.000 inch	25.4 mm
Grade 2	G2	0.500 inch	12.7 mm
Grade 3	G3	0.223 inch	5.60 mm
Grade 4	G4	0.100 inch	2.54 mm
Grade 5	G5	0.046 inch	1.18 mm
Residue	G5	Material passing through 0.046 inch or 1.18 mm opening	

Actual size grading was accomplished with a commercial mechanical shaker with nested screens. The waterscreen debris was agitated in small lots for 30 seconds, a length of time determined to be adequate for complete size separation with minimum damage to the artifacts. The question of damage to the artifacts from this procedure has been considered. The damage to stone artifacts is minimal, and can readily be separated from patterned aboriginal use wear. Bone tools are much softer, hence more subject to damage from water screening and size grading. Any damage produced during these procedures will be inconsequential for this study, since use-wear analysis will be not be a major focus. However, examination of the bone tools indicates minimal recent damage, suggesting that water screening and size grading do not prohibit later microscopic analysis of bone artifacts. The disadvantage of creating minor artifact damage is greatly outweighed by the benefits of size grade structured analysis.

Sorting and Analysis

Sorting of the village cultural materials is accomplished in two steps. In the initial sorting, size graded materials are broken down into their constituent classes. Size grades 1-3 are completely sorted, as materials from those grades are relatively large and easily separated. Grades 4 and 5 are only partially sorted, due to the small size of the materials, and their extremely large volume. Grade 5 in particular is difficult to deal with, as it is roughly the consistency of kitty litter. Sorting for items such as small trade beads can be a long, trying experience. Residue which passes through the grade 5 screens is discarded, since it is smaller than the openings in the field waterscreens and was retained fortuitously.

The second sorting procedure is more intensive and is designed to lay the groundwork for more detailed analyses to follow. For example, stone tools are separated from flaking debris, and pottery is separated into body and rim sherds. Table 4 presents a detailed breakdown of sorting procedures in preparation for future analyses.

Detailed analysis of specific material classes follows the sorting procedures. Most major material classes were analyzed at the University of North Dakota, including stone tools and pottery. Minor material classes such as fire cracked rock, clinker, shell, trade beads, and metal were all analyzed and integrated into the final reports. Details of analysis results for the three villages may be found in those final reports (Ahler et al. 1980; Ahler and Weston 1981; Ahler and Swenson 1985).

Given the emphasis of this study upon modified bone, analysis of faunal materials is of greatest interest. Faunal remains were extremely dense in the village deposits, and were composed primarily of bison. After separation from the other material classes according to the procedures presented in Table 4, all faunal materials with the exception of unmodified, unidentifiable bone from grades 4 and 5 were shipped to Carl R. Falk in Sevierville, Tennessee. Mr. Falk's long experience in analysis of Middle Missouri faunal assemblages made him an ideal specialist to deal with the KNRI materials (Falk 1977). Falk and his staff conducted all further taxonomic and analytic studies on the faunal materials, including separation of modified bone artifacts. Those procedures will be described in detail in a later section.

Assignment of Village Components

On the basis of excavation data and detailed analysis of

Table 4. Laboratory sorting procedures utilized at Lower Hidatsa, Sakakawea, and Big Hidatsa. (Ahler and Swenson 1985:71 Table 6).

Material Classes in Initial Sort	Material or Artifact Classes in Second Sort	Size Grade Sorted From G1	G2	G3	G4	G5
Modified Stone	Stone Tools	X	X	X	X	
	Chipped Stone Flaking Debris	X	X	X	X	
Pottery	Rim Sherds	X	X	X		
	Body Sherds	X	X	X		
Vertebrate Fauna	Modified Bone	X	X	X	X	X
	Unmod. Identifiable Bone	X	X	X	X	X
	Unmod. Unidentifiable Bone	X	X	X		
Shell	Modified Shell	X	X	X	X	X
	Unmod. Identifiable Shell	X	X	X	X	X
	Unmod. Unidentifiable Shell	X	X	X		
Fire-Cracked Rock	Check For Tools	X	X	X		
Unmodified Clinker	Check For Tools	X	X	X		
Burned Earth/ Fired Clay	Burned Earth	X	X	X		
	Fired Clay Without Temper	X	X	X		
	Fired Clay With Temper	X	X	X		
Ash	Ash	X	X	X		
Ochre/Pigment	Ochre/Pigment	X	X	X	X	
Metal	Recent Metal	X	X	X	X	X
	Trade Metal	X	X	X	X	X
Glass Trade Beads	Glass Trade Beads	X	X	X	X	X
Miscellaneous	Other Glass	X	X	X	X	
	Glazed Pottery	X	X	X	X	
	Leather	X	X	X	X	X
	Fired Clay Objects	X	X	X		
	Coprolites	X	X	X		
	Fused Silica	X	X	X		
Natural Rock	Natural Rock	X	X	X		
Unsorted Residue	Unsorted Residue				X	X

cultural materials, components were assigned for each of the villages. The process by which components were delineated, and the resulting chronological sequence will be briefly described here. A more detailed discussion of components as related to modified bone assemblages will follow in a later section.

Lower Hidatsa Components

At the Lower Hidatsa site, components were assigned on the basis of results from the five 1978 University of North Dakota excavation units, as well as Lehmer's two excavation units. Each excavation unit had its own complex stratigraphic sequence. The degree of complexity was such that it was not possible to make stratigraphic connections between excavation units, even those located only a few meters apart. This was also the case in the other two villages. It was therefore necessary to derive some means of comparison between units which might lead to the construction of components.

The first step in deriving components was to construct a series of horizons for each excavation unit (Ahler and Weston 1981:61). The horizons were defined on the basis of stratigraphy and artifact content. Two or more excavation levels were often combined in order to provide a significant quantity of artifacts for analysis but in no case did any horizon cross a major stratigraphic boundary. Most of the occupation is spanned by AC unit 3, which illustrates the level of stratigraphic complexity in the village (Fig. 8).

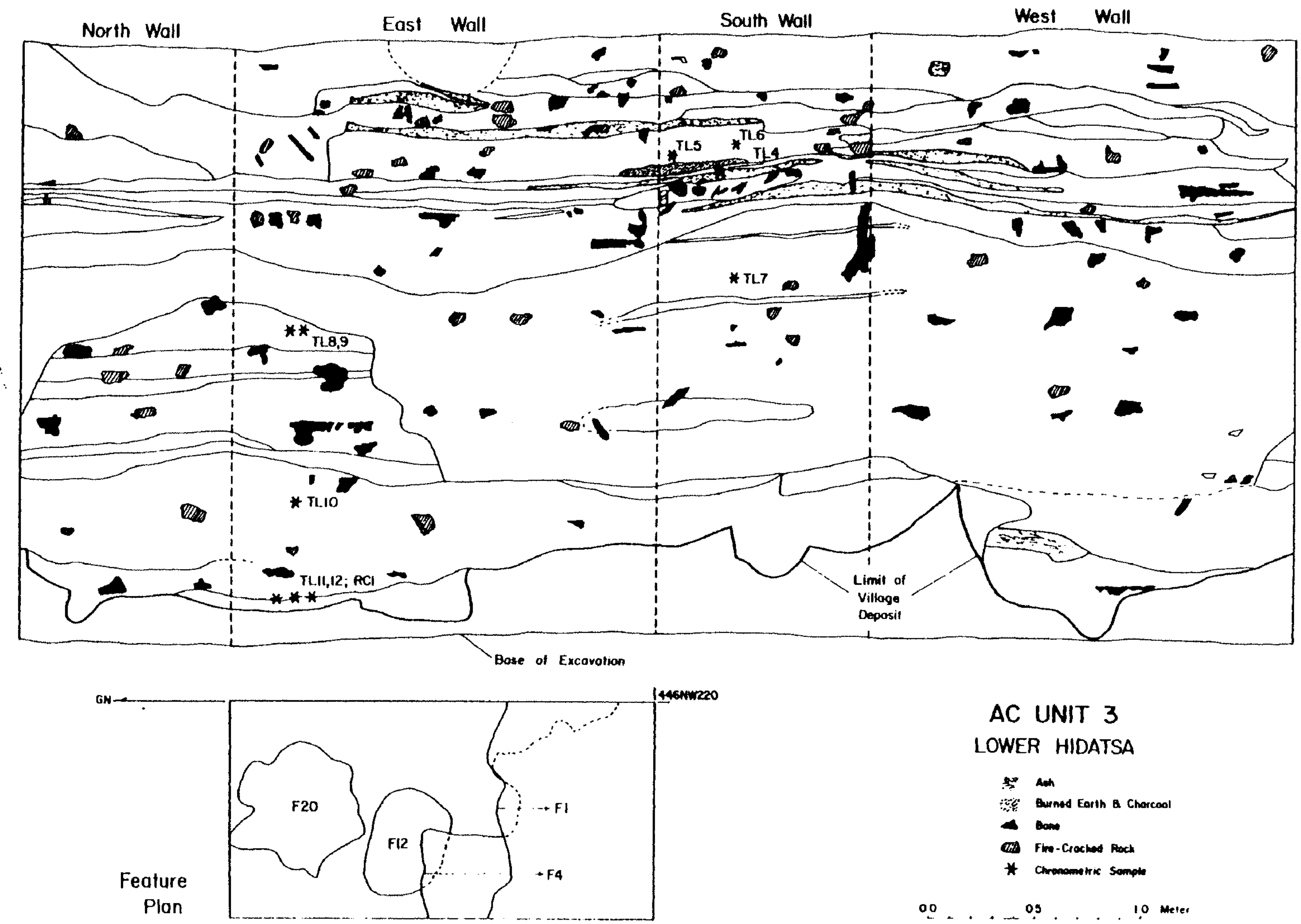


Figure 8. Plan and profile drawings of AC unit 3, Lower Hidatsa village showing the depth and complexity of midden deposits at the northern site margin (Ahler and Weston 1981:40 Fig. 5).

After the horizons had been established, a series of temporal periods or components were constructed (Ahler and Weston 1981:62). These crosscut the excavation units, and were designed to illustrate the periods of occupation in the village. Horizons were combined into temporal periods on the basis of stratigraphy, and especially on artifact content. It was originally believed that the site was occupied for approximately 100 years, with abandonment of the village being forced by the 1780 smallpox epidemic. That 100 year occupation was divided into three periods. The key points dividing them are the presence or absence of trade material, thickness of body sherds, and the relative frequency of three major pottery types (Table 5).

Table 5. Variables used in the determination of temporal periods at Lower Hidatsa. (Ahler and Weston 1981:63 Table 5).

Temporal Period	Trade Mater.		Mean G2 Body Sherd Thickness		Pottery Wares: Le Beau S-Rim	Trans. S-Rim	Knife River/ Deapolis
(1) A.D. 1750-1780	50	n x	1205 5.31	n x	24 24.5	2 2.0	72 73.5
(2) A.D. 1710-1750	27	n x	1847 5.27	n x	125 70.2	30 16.9	23 12.9
(3) A.D. 1680-1710	0	n x	1214 5.07	n x	121 94.5	1 0.8	6 4.7

The waterscreen recovery system allows some confidence in the absence of trade materials from the earliest period. Pottery thickness (G2) is an important variable, in that it is an indicator of the decline in pottery technology brought about by population reductions during smallpox epidemics.

The earliest period at Lower Hidatsa has all the characteristics of the Heart River Phase, as expressed at the White Buffalo Robe site (Lee 1980). These characteristics are a very high percentage (94.5) of LeBeau S-Rim ware and complete lack of trade materials. LeBeau S-Rim ware is thin and well made, with a distinct S-shaped rim and prominent cord impressions (Ahler and Weston 1981:61).

The second period is early Protohistoric in age, and was described as an unnamed phase (Ahler and Weston 1981:62-63). Some trade materials (27) were present, and the presence of Transitional S-Rim ware pottery was documented. This pottery has elements of both LeBeau S-Rim ware, and the later out-flared Knife River ware. As discussed earlier, this pottery is quite similar to Pingree wedge-rim ware from the Stutsman Focus in the James River Valley (Wheeler 1963:195-196). It has also been found at the Midipadi Butte site on Lake Sakakawea (Kuehn et al. 1984).

The third period corresponds to the Knife River Phase (Lehmer et al. 1978). The predominant pottery is thick, poorly made Knife River ware, and trade materials are numerous. This period at Lower Hidatsa predates the 1780 smallpox epidemic, suggesting the possibility of an earlier epidemic around 1750 (Ahler and Weston

1981:64).

After completion of the final report (Ahler and Weston 1981), additional thermoluminescence and carbon-14 dates became available. These indicate that the site occupation began much earlier than had originally been believed. It now appears that the occupation began in the mid-1400's, and continued until 1780. Table 6 shows the sequence at Lower Hidatsa as currently defined. The original sequence of the three periods is retained, but a finer chronological division is attempted, and a much longer occupation is described (Table 6). With some modifications, this sequence will be used for subsequent modified bone interpretations

Sakakawea Components

The circumstances of occupation at Sakakawea were somewhat different than those at Lower Hidatsa. The occupation was much shorter, and later in time. It began in 1797/98 and ended in 1834/37, depending upon which version of the village's demise is accepted (Ahler et al. 1980). As was the case at Lower Hidatsa, the analysis was structured around horizons within each of the excavation units. All of the occupation falls taxonomically within the Knife River Phase, and was treated in that manner in the final report (Ahler et al. 1980).

Recent information from excavations, cutbank profiling, and proton magnetometer survey show that the site holds two sequentially occupied villages (Ahler et al. 1980:196). The first village was briefly occupied and then burned. It is represented by three burned

Table 6. Revised component sequence at Lower Hidatsa village, based upon reanalysis of ceramics and chronometric information (Ahler n.d.:2).

Time Period	Estimated Dates A.D.	Excavation Series
1	1748-1780	UND/NPS
2	1700-1740	UND/NPS
3	1650-1700	UND/NPS
4	1600-1650	UND/NPS
5	1525-1600	UND/NPS
6	1450-1525	UND/NPS
Mixed	1450-1780	UND/NPS & Lehmer
1-2	1700-1780	Lehmer
3-4	1600-1700	Lehmer
3-6	1450-1700	Lehmer
5-6	1450-1600	Lehmer

roof fall concentrations in the cutbank and a similar level in one test unit away from the cutbank (Fig. 9). It is also represented by one central hearth in the cutbank, and 9 or 10 buried central hearth locations found during the course of proton magnetometer survey. The later village is the one visited by most of the traders and explorers. It contains 31 earthlodge depressions now visible on the surface.

Recently, intensive analysis of ceramics and historic documentation has led to a more detailed sequence of components at the site. This sequence seeks to isolate the early village from the later occupation, resulting in three unmixed and two mixed periods (Table 7). With some modifications, this framework will be used for subsequent analyses of modified bone assemblages.

Big Hidatsa Components

At Big Hidatsa, a similar procedure of component assignment was followed. All of the excavation units were first divided into horizons. Many of the horizons include more than one excavation level, established under the following guidlines. No horizon crosscuts an observable stratigraphic break, the frequency of trade materials does not show a major break between levels combined into a horizon, and each horizon contains sufficient cultural materials for analysis without violating the other conditions set forth above (Ahler and Swenson 1985:87). As was the case at Lower Hidatsa and Sakakwea, the Big Hidatsa stratigraphy is very complex, as shown in

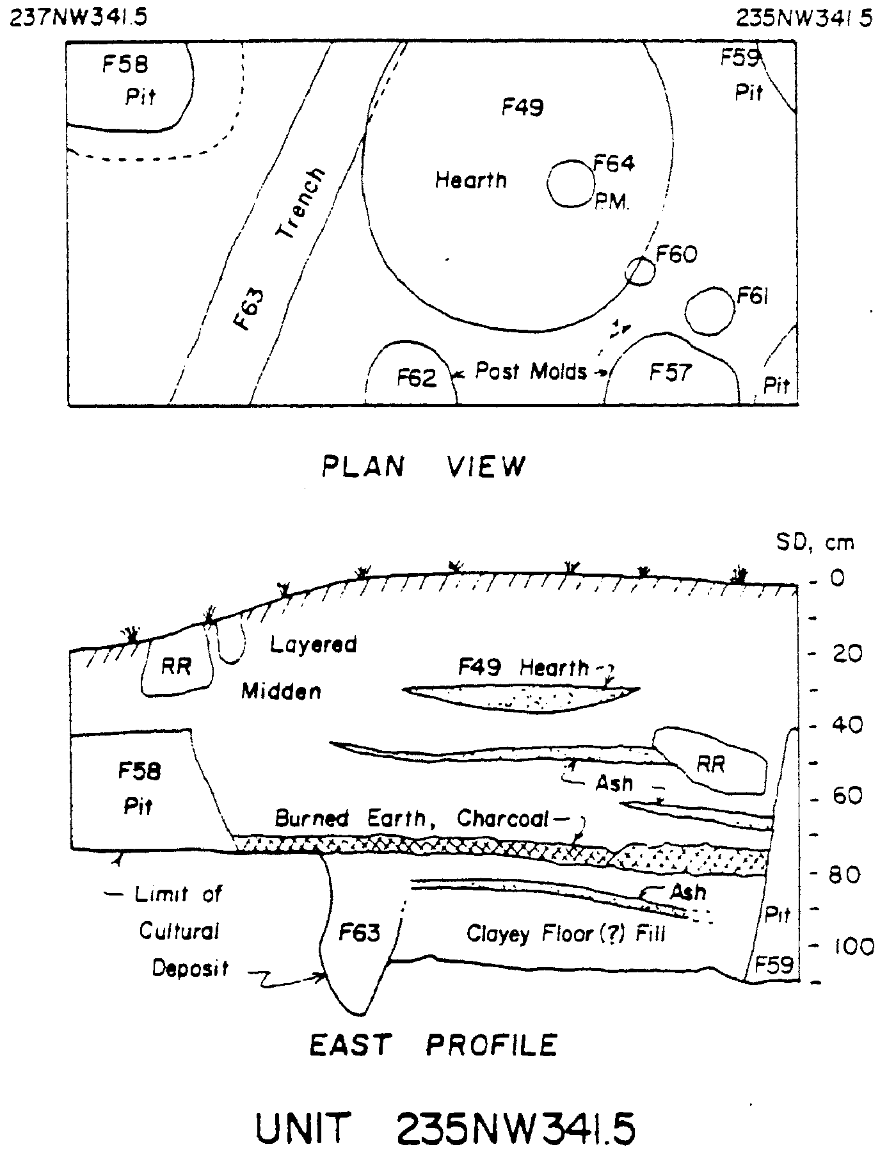


Figure 9. Plan and profile drawings of excavation unit 235NW341.5 at Sakakawea village, showing the distinct layer of burned earth and charcoal representing the earliest village (Ahler et al. 1980: 64 Fig. 9).

Table 7. Revised component sequence at Sakakawea village, based upon reanalysis of ceramics and historic documentation (Ahler n.d.:3).

Time Period	Estimated Dates A.D.	Context
1	1815-1834/37	All outside house deposits, latest period.
2	1800-1815	All outside house deposits, middle period.
3	1795-1800	Burned roof and floor material, earliest period.
4	1800-1834/37	All inside house deposits, mixed middle and latest periods. (2-3)
5	1795-1834/37	All other collections: mixed (1-3).

Figure 10, which illustrates one of the deepest excavation units in the core area of the site.

Seriation of the horizons was accomplished with factor analysis, in order to isolate time-sensitive variables. The procedure provided a tentative chronological sequence for some of the horizons. These were evaluated and finalized using independent data and those horizons not part of the factor analysis scheme were added to the chronological structure. Six carbon-14 dates and ten thermoluminescence dates provided some of the necessary chronological control (Ahler and Swenson 1985:102). When combined with historic documentation, a sequence of time periods or components was derived (Table 8). This sequence will provide the framework for analysis of modified bone assemblages at the site.

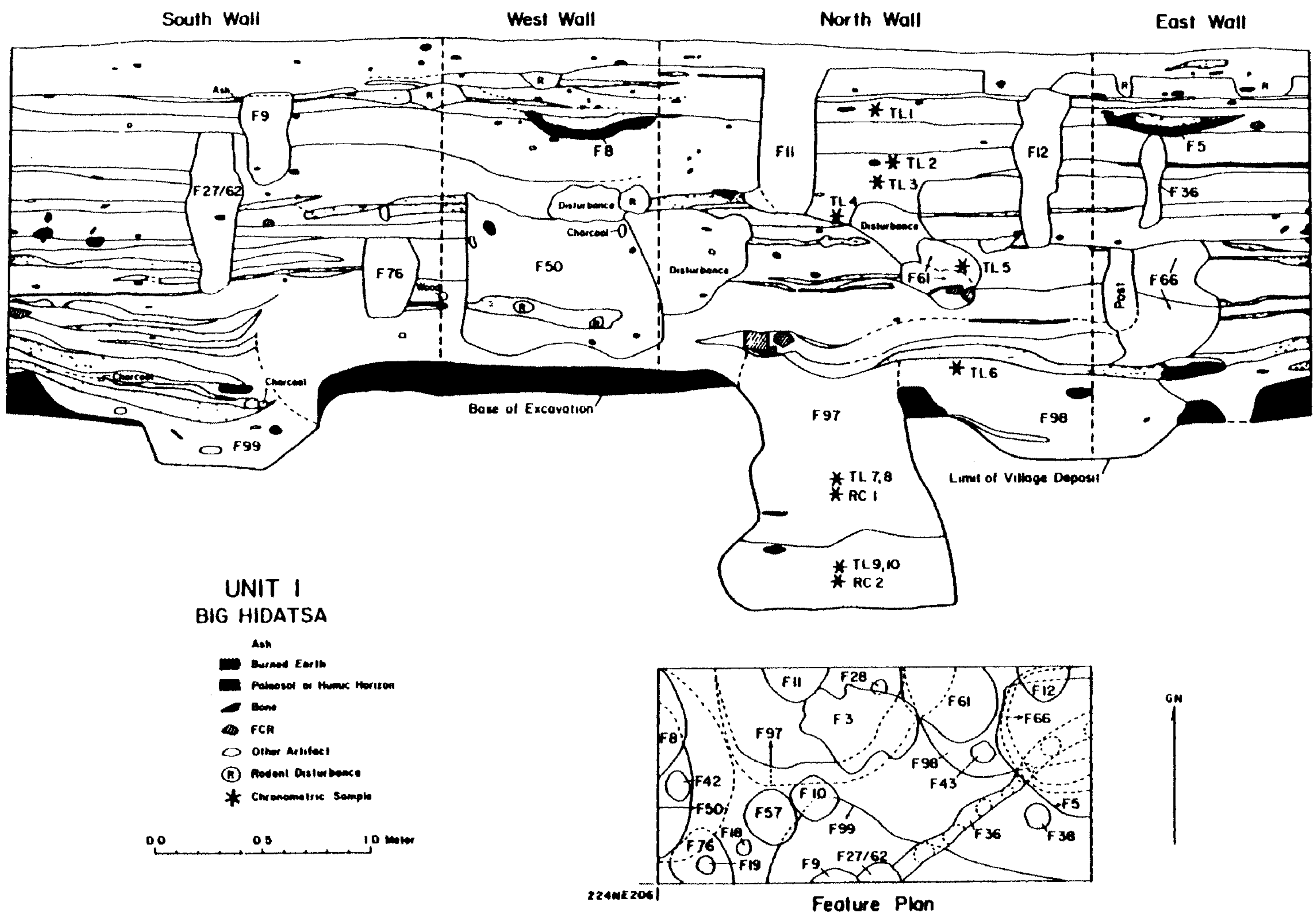


Figure 10. Plan and profile drawings of excavation unit 1 in Big Hidatsa village, illustrating the depth and complexity of midden deposits in the core area (Ahler and Swenson 1985:46 Fig. 17).

Table 8. Big Hidatsa village time periods, associated calendar ages, and hypothesized activities. Information derived from the 1980 UND/NPS excavations (Ahler and Swenson 1985:112 Table 18).

Time Period	Estimated Dates A.D.	Comments
1	1830-1845	Coincides with presence of permanent trading posts near the Knife River and steamboat traffic from St. Louis; Hidatsa lose their role as middlemen in the Fur Trade.
2	1790-1830	Period of direct trade, first from Canada, and then from St. Louis, with the establishment of short-lived posts at the Knife River; maximum involvement for the Hidatsa as middlemen in the Fur Trade.
3	1745-1790	Late indirect trade period, resident traders probably relatively common; Hidatsa take on the role of middlemen in the Fur Trade.
4	1700-1745	Middle indirect trade period, resident traders uncommon, Hidatsa near the end point of the Euro-American trade network.
5	1650-1700	Early indirect trade, no resident traders; Hidatsa near the end point of the Euro-American trade network.
6	1600-1650	Earliest indirect trade begins in this period, trade artifacts have probably passed through the hands of multiple middlemen.
7	1400-1500	Scattered Village complex occupation.
8	?	Pre-Plains Village, possibly up to 2000 years in age.
9	?	Mixture of undated, intrusive Plains Village deposits and possible pre-Plains Village period artifacts.
10	1600-1745	Mixed or compressed deposits probably representing time periods 4, 5, and 6.

DEVELOPMENT OF MODIFIED BONE ANALYSIS

The study of modified bone assemblages has a long history, but has never been as prominent in the literature as lithic or ceramic analyses. Nevertheless, valuable contributions to the study of prehistoric change have been made through analysis of modified bone assemblages. The potential for such studies is considerable, and will be explored in this research project. The following section will discuss the development of modified bone studies, and will examine current trends in the literature. It will conclude with a description of the analysis framework used in this study, and a discussion of models of prehistoric change.

The literature dealing with modified bone is divided into two distinct aspects. The first is closely connected with faunal analysis and views bone artifacts as faunal elements. Studies of this type focus on carcass breakup and distribution using taphonomic principles. Experimental analogs are often constructed to derive bone fracture patterns and wear characteristic of human use. The best known, and most controversial of these studies are concerned with sites where no evidence of human habitation other than faunal assemblages is present. Bone tools in this context are modified only by fracture, and are often difficult to distinguish from bones fractured by non-human agencies. Information gleaned from study of extant hunting and gathering groups such as the African Bushmen and the Alaskan Nunamiut is used to supplement experimental analogs and taphonomic information. This aspect of modified bone research is by far the most prevalent in the literature today.

The second major aspect of modified bone analysis consists of studies which treat bone tools as artifacts, rather than as faunal elements. Such studies focus on formal bone tools from habitation sites, where there is no doubt of human presence. Formal tools are those intentionally modified from their original faunal form for a functional purpose. They are distinguished from fortuitous or expedient tools, which are unmodified except by fracture. This aspect of bone research is the major focus of the present study. Such studies are substantially less frequent in the literature than those described above.

The following section will discuss both major aspects of modified bone research, that dominated by taphonomic studies, and that emphasizing formal bone tools from unquestioned habitation sites. It will conclude with a discussion of modified bone analysis in the present study and models of prehistoric change.

Taphonomic Studies

Recent study of modified bone has focused on consideration of the factors operating on bones from the time they are parts of animals, to the time they are available for study in research collections. The field of study appropriate for such work is taphonomy. Taphonomy provides an organized framework with which to study post-mortem processes operating upon a faunal assemblage passing from the biosphere to the lithosphere (Ephremov 1940; Lawrence 1968; Bonnichsen and Will 1980). The goal of taphonomic research is to arrive at an accurate reconstruction of a faunal assemblage, after consideration of all influencing factors (Bonnichsen and Will 1980:7). Taphonomy is based upon the principle of uniformitarianism, whereby modern-day processes are used as the baseline analogs for studies of past processes. Experimental analogs are employed when modern-day observational analogs are not available. Figure 11 provides a general model of taphonomic factors which affect faunal assemblages, and will provide the outline for further discussion. Examples from the Plains will be used to illustrate each concept.

Hunting

Hunting, or death by human agent (Fig. 11), is a major means by which faunal assemblages enter the lithosphere. The peoples of the Plains, both nomadic and sedentary, depended heavily upon the bison. There is considerable historic and archaeological evidence for bison hunting techniques among the Plains peoples. Unlike domestic cattle, bison are large fast herd animals, and communal effort is necessary in order to hunt them effectively (Frison 1978). A good review of historic information is provided by Wheat (1972:85-124), who describes communal bison hunting techniques, including drives and surrounds. Substantial archaeological information is also available, especially on the Northwestern Plains, where remains of hunting features such as drive lines, pounds, and corrals have been found (Frison 1978). Communal hunting sometimes resulted in

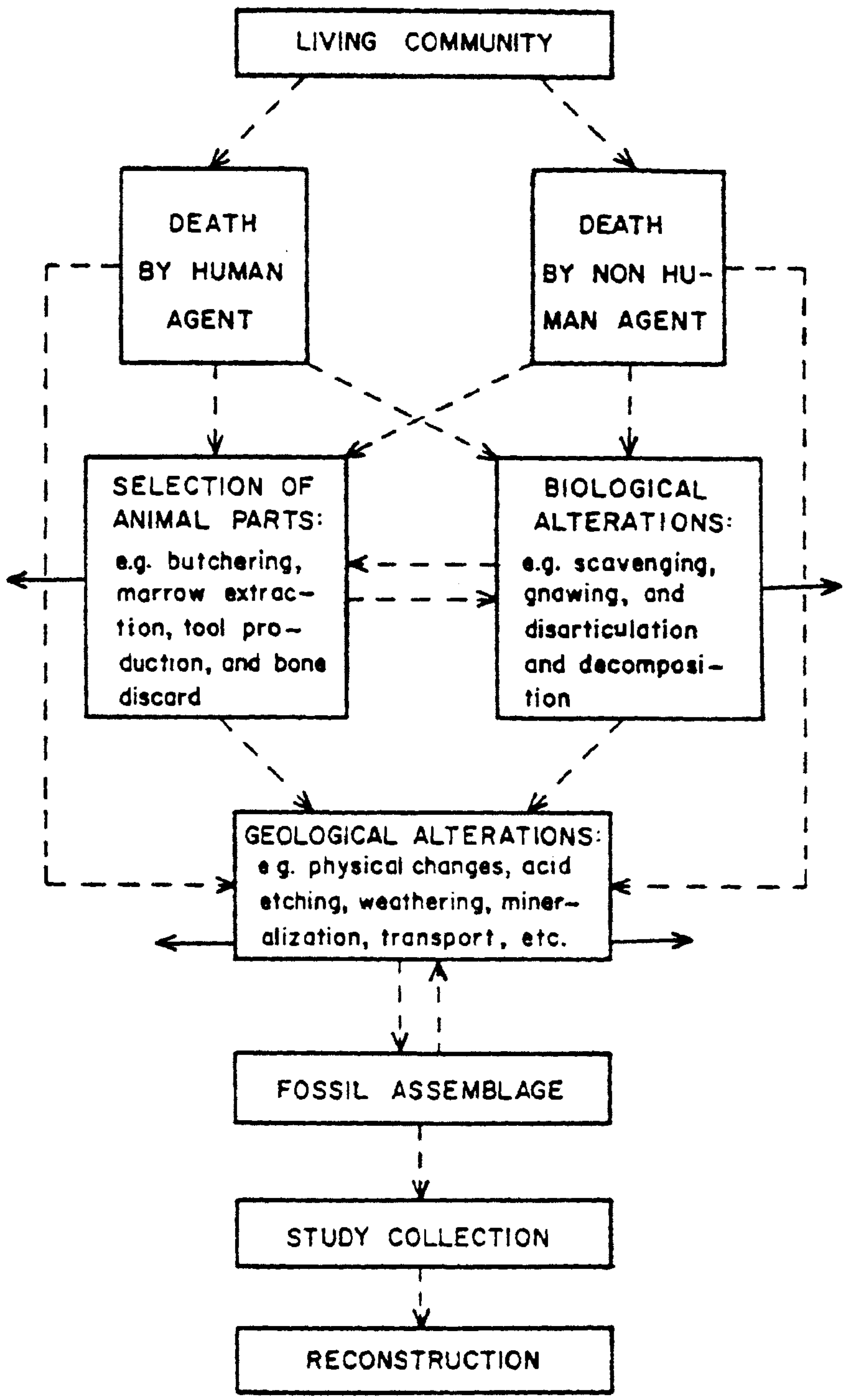


Figure 11. General model of taphonomic factors influencing faunal assemblages and bone tools from living community to study collection. (Modified from: Bonnichsen and Will 1980:8 Fig. 1).

procurement of more meat than a group could use, as evidenced by remains at the Olsen-Chubbuck site (Wheat 1972).

The village tribes in the KNRI area hunted bison regularly, depending upon the herds for a substantial portion of their subsistence (Lehmer 1971:55). This is clearly shown in the tremendous quantity of bison bone in the KNRI village sites, as well as in the ethnographic literature (Wheat 1972, Frison 1978, DeVoto 1947).

Butchering

After an animal has been procured in the hunt, the next step is to butcher it effectively, so as to make the meat usable for consumption. The procedures followed during the butchering process condition the selection of faunal elements which will ultimately be made into tools (Fig. 11). A wide variety of butchering techniques have been employed by aboriginal peoples. All consist of some organized pattern to render the animal carcass usable for the hunters and their families.

On the Plains, many examples of butchering techniques have been discovered in archaeological contexts (Gilbert 1969). Among the best known is that from the Olsen-Chubbuck Paleo Indian site on the High Plains of eastern Colorado (Wheat 1972). The site consists of a narrow arroyo, filled with bison bone from a single communal hunting drive, and Wheat was able to reconstruct the butchering sequence through careful excavation and extensive review of the historic literature. Another good example is the Early Plains

Archaic Hawken site in Wyoming were the excavators were able to illustrate the distribution of prehistoric butchering cut marks on bison skeletons (Frison et al. 1976). This was followed with a further discussion of butchering techniques in the context of experimental use of stone and bone tools (Frison 1978:301-328). The development of experimental analogs is very important in the study of simple bone tools and will be discussed below.

In the Middle Missouri, as in many other areas, faunal analysis was not a major research interest for the earliest investigators. Recently, however, faunal analysis has assumed a more central role in Middle Missouri prehistoric studies. Current faunal analysis is based upon a series of articles by Theodore White (1952a; 1952b; 1953a; 1953b; 1954; 1955; 1956) in which he set out a series of specified research questions and the means for achieving them. Among those research questions are the determination of age of hunted animals, frequencies of faunal elements brought from the kill site to camp, distribution of right and left elements, and determination of relative species abundance in each assemblage (Falk 1977:152-153). White also examined butchering patterns in the Middle Missouri as an aspect of faunal analysis (Falk 1977:156). This was followed by a discussion of butchering patterns at the Paul Brave, Huff, and Demery sites where significant differences were found, possibly related to ethnic or tribal affiliation (Wood 1967:183-187). Faunal analyses have also been conducted on assemblages from sites in the KNRI vicinity including the White

Buffalo Robe (Falk et al. 1980), and the Mondrian Tree site (Falk 1983).

One very important aspect of butchering is marrow extraction. Marrow is highly nutritious, and is extracted from long bones by cracking them open. The resulting fractures produce sharp fragments, some with articular ends attached. Some of these fragments are used as simple tools, with no other modification. They will be more fully discussed below. Also, the distribution of fragments resulting from marrow extraction can be used to infer the presence of human occupation when no other evidence is present. The production of bone grease is another byproduct of butchering. In this process, small bone fragments are boiled until a nutritious grease collects on the water's surface and is skimmed off (Leechman 1951, Vehik 1977). The residue from bone grease production has also been used to infer human habitation in sites with no other evidence of occupation.

The distribution of bones resulting from hunting and butchering have been approached from a modern perspective in recent literature. Both Yellen (1977) and Brain (1981) have worked with extant African groups in an effort to construct modern analogs which might explain the patterns of bone discard characteristic of human activity. Binford (1978a, 1981) has conducted similar research among the Alaskan Nunamiut. These studies all have bearing upon biological alterations of faunal assemblages and will be discussed below. Geological alterations such as fluvial transport will also be examined (Fig. 11).

Development of Bone Tool Studies

There is a major two part distinction in the modified bone literature. The first consists of the study of simple bone tools, unmodified except by fracture. This category has attracted most of the attention in the current literature, especially when bone tools are employed as evidence of human habitation in sites containing no other cultural evidence. The second category treats bone tools as formal artifacts, with less emphasis upon their context within a faunal assemblage. These two categories of bone tool analysis will be examined below in the context of the development of modified bone analysis.

Analysis of Simple Expedient Bone Tools

Analyses of modified bone assemblages began in Europe early in this century, and have been recently summarized by Binford (1981:6-20). One of the earliest interpretations of bones as tools was undertaken on a faunal assemblage from the Mousterian levels of Vogelherd, a large cave in Germany (Reik 1934, in Binford 1981:9). The shapes and fracture patterns of the animal bones encountered were suggestive of human tools, and were interpreted as such. Similar conclusions were reached after analysis of faunal collections from the Chinese *Homo erectus* site of Choukoutien (Breuil 1938; 1939). The shapes of the bones and their distinctive longitudinal fractures led Breuil to postulate that they were tools produced by the hominid cave occupants. He postulated an age of bone prior to the advent of stone tools, when animals were killed and their bones used for implements.

Certainly the best known and most controversial of these studies is the work of Raymond Dart at Makapansgat in South Africa (Dart 1957, 1959, 1961). His research was among the earliest to deal with Australopithecine remains. Dart argued that Australopithecines were part of human ancestry on behavioral grounds, since he believed that the animal bones found in their sites had been used as tools (Binford 1981:12-13). He hypothesized an osteodontokeratic (bone-tooth-horn) industry after observing modifications on the bones which were interpreted as having been caused by use wear. In addition, he believed that the distinctive long bone spiral fractures observed in the collections had been produced by a crack and twist motion, whereby the bone was struck in mid-shaft and twisted apart by grasping the ends. The animal skeletons in the cave were not complete, and Dart attributed this differential preservation to selected transport of carcass parts to the cave by the Australopithecines (Binford 1981:13). One of Dart's most controversial suggestions was that the Makapansgat Australopithecines were cannibals, based upon observed skeletal damage (Brain 1981:3-10).

Dart's ideas did not find ready acceptance. Most of the objections came from researchers who believed that the Makapansgat faunal assemblages had been modified through biological agencies, and not by the Australpithecines (Fig. 11). The arguments on both sides have been recently summarized by Wolberg (1970). The most effective rebuttal came from C. K. Brain (1967, 1969,1981) who had worked with extant African Hottentot groups. On the basis of his observations of discarded Hottentot goat carcasses, Brain concluded that scavenging by dogs would have produced the differential anatomical frequencies observed by Dart at Makapansgat (Binford 1981:191). Also, he discovered that scavanging and trampling of bones produced very convincing psuedotools, similar to those found by Dart and attributed to the osteodontokeratic industry (Brain 1981:15-17). In another well known study, Yellen (1977) worked among the Bushmen of southern Africa, with similar conclusions regarding faunal assemblages.

Other studies of carnivore alterations of bone assemblages followed. Some dealt specifically with faunal assemblages in Australopithecine sites (Washburn 1957; Read-Martin and Read 1975), while others focused on faunal assemblages in general (Shipman and Phillips 1976, 1977; Sutcliffe 1970, 1973; Kitching 1963; Haynes 1980; Binford 1981). One example of differing interpretations regarding human use versus carnivore alteration of a faunal assemblage concerns bones from the Mousterian levels of Cueva Morin in Santander, Spain. Among the bones are those items interpreted as flaked bone artifacts, manufactured by the human occupants of the cave (Freeman 1978, 1983). On the basis of information gathered from Nunamiut faunal assemblages, Binford (1983a) interprets the materials as having been produced by carnivore gnawing. After a very sharp exchange, Freeman (1983) stood by his original interpretation of an extensive Mousterian flaked bone industry at Cueva Morin.

In the New World, there are early sites where bone tools are the only indicators of human activity. The best known and most controversial is Old Crow, located in the Yukon Territory of Canada. The faunal assemblages were found in secondary deposits along the Old Crow River. The initial find was a flesher, a formal tool dated to 27,000 years B.P. (Harrington 1975; Harrington et al. 1975). As a result of this discovery, intensive research was launched in the area, aimed at discovering evidence of early human occupation in the New World. Recently, a new date for the flesher was obtained using accelerator mass spectrometry. The date (1350 + 150) is almost 26,000 years younger than that originally measured, probably due to contamination of the bone apatite by groundwater carbonates (Nelson et al. 1986). Another group of artifacts, consisting of mammoth bone flakes and cores were dated using the same procedures and were found to be of Pleistocene age, as originally postulated.

Research in the Old Crow Basin resulted in the discovery of numerous simple bone tools which had not been altered except by fracture (Bonnichsen 1979; Morlan 1979, 1981). On the basis of these materials, an early occupation in the New World of 31,000 years B.P. has been postulated. The Old Crow bones were in secondary river deposits, but the river is very sluggish and contains fine-grained sediments. The investigators therefore postulated that the bones were near their primary source, and had suffered little alteration from transport (Morlan 1979). This is an example of geological alteration, as illustrated in Figure 11. Factors such as transport must be considered when dealing with faunal assemblages and simple bone tools such as those at Old Crow, since experiments have shown that considerable movement and transportation alteration of bones is possible in a fluvial environment (Boaz and Behrensmeyer 1976).

Much of the argument for human modification of the Old Crow materials is based upon experimental analogs (Bonnichsen 1979:35-60). During experimentation, the structure of bone was found to be important in the determination of fracture patterns. Bone is a brittle, complex substance, composed of apatite crystals and longitudinally oriented collagen bundles (Bonnichsen 1979:13-14). Repeated experiments show that a sharp blow (dynamic loading) to the mid-shaft of a long bone will produce a very distinctive spiral fracture similar to those produced by the extant Calling Lake Cree groups in Canada (Zierhut 1967). This is true only of green bones, as fossilized bone breaks in a much different manner, easily distinguished from green bone fracture. Experimentation also focused upon bone flaking, as artifacts composed of bone flakes have been identified at Old Crow (Bonnichsen 1979:51-52).

Bonnichsen´s bone fracture experiments are certainly not the only recent New World attempt to construct experimental analogs. Another notable example is the work of Sadek-Kooros (1972, 1975) who has conducted extensive bone breaking experiments. They were designed to help explain faunal assemblage variation at Jaguar Cave in Idaho (Binford 1981:149).

Experimental butchering has also been conducted in order to test inferences regarding bone tools from Old Crow. The best known example concerns the butchering of an elephant named Ginsberg, primarily with flaked bone tools (Stanford et al. 1980; Park 1978). The participants were convinced of the suitability of the tools for the task of butchering so large an animal.

New World Ethnographic Studies

Ethnographic studies have been conducted in the New World in order to construct observational analogs, which can be used to understand hunting patterns and the resulting distribution of artifacts and animal bones. The best known and most often cited of these is Binford's work among the Alaskan Nunamiut (Binford 1978a). A later work focused entirely upon Nunamuit faunal assemblages and their value for interpretation of the archaeological record (Binford 1981). The book contains an extensive discussion of carnivore scavenging and its effects upon bone assemblages. The examples presented are the result of processes such as gnawing, crunching, and digestive erosion. From these results, Binford concludes, among other things, that the Old Crow materials were the products of post-mortem carnivore alteration, not human modification. Other researchers have reached similar conclusions regarding the Old Crow bone tools (West 1983). Some of the other conclusions reached during Binford's Nunamiut research will be discussed below.

Another important aspect of research among the Nunamiut was to record the distribution of faunal elements at all major activity locations. The goal was to record the types of artifact and faunal distributions left by known activities and from that to determine the validity of interpretations of prehistoric artifact distributions. The most detailed investigation of this type was carried out at the Mask site, a Nunamiut hunting stand (Binford 1978b). Binford recorded the distribution of artifacts around several outdoor hearths and defined several zones of discard, including a drop zone directly in front of the seated hunters and a toss zone at a slightly greater distance from the hearth. The bone distributions did not include any tools. They had, however, been fractured by the hunters to obtain marrow, and had been discarded after eating. A model of hearth location and discard zones was developed from the Mask site distributions for application to archaeological data.

The distributional importance of bones and bone tools is well known, even in the absence of ethnoarchaeological data. A good example from the Old World is Pincevent I, a Magdalenian site dated at about 15,000 years B.P. (Leroi-Gourhan and Brezillon 1966). All artifacts on the living surface were meticulously plotted by the excavators. The resulting distribution led them to the conclusion that the hearths at the site had been covered with a skin tent or similar light structure. Binford applied his model of hearth location and discard zones developed at the Mask site and arrived at much different conclusions. He believes that the Mask site model shows that the hearths at Pincevent were located outdoors, with no structure over them (Binford 1983b:156-160). He maintains that the hearths were used alternately as the wind shifted, and the people seated around them turned from one to the next, just as was observed at the Mask site.

Regardless of the merits of comparing a modern Eskimo hunting stand with a 15,000 year old Magdalenian site, the point of this aspect of ethnoarchaeological research is that it makes investigators more aware of the value of bone distributions within archaeological sites. It also provides models of interpretation for observed distributions of bones. An example would be concentrations of small bone fragments which might be interpreted as the remains of bone grease processing, on the basis of ethnoarchaeological research.

Expedient Bone Tools

Faunal assemblages did not receive close scrutiny during early Plains investigations. Recent intensive investigations of faunal assemblages have revealed simple bone tools, defined as expedient bone butchering tools. Their definition differs somewhat from sites such as Old Crow, since they are not the sole determining evidence for human habitation. Expedient bone butchering tools have been defined in a series of Plains sites, first at the Glenrock Buffalo Jump (Frison 1970), and they have been more fully discussed in the context of experimental butchering (Frison 1978:301-328). Expedient tools are simple, are made in the butchering area, and are used in processing and then discarded. Only the knowledge of their use needs to be brought to the kill site (Johnson 1982). In use, they were employed to chop away muscle attachments. Experimental use in bison butchering has found them to be superior in many ways to stone tools in this capacity (Frison 1978:305-311). Expedient tools often are made from long bones with spiral fractures. As discussed above, this fracture pattern can be created during marrow extraction or deliberately in tool manufacture. Those deliberately manufactured for the purpose show flake scars from production, often away from the working edge (Johnson 1982:147). After butchering, the working edges show clear rounding and smoothing. The time depth of these tools is considerable, from Paleo-Indian until Euro-American contact (Frison 1970, 1974; Johnson 1982).

The interpretation of expedient tools has not met with universal acceptance. Binford (1981) believes that the faunal assemblage at the Glenrock Buffalo Jump (Frison 1970) had been ravaged by carnivores, which produced the bones identified as expediency tools. Spiral fractures are not entirely unique to human modification, in that convincing spiral fractures have been found on bones from Miocene deposits, where they were presumably produced by trampling (Myers et al. 1980).

The author´s positions on issues outlined above are as follows. The interpretations advanced by Breuil, and by especially Dart seem somewhat fanciful today. The possibility of carnivore alterations was not considered at that time. Recent investigations suggest that this is a much more likely explanation of the variation observed than hominid alteration. The case of Old Crow is different. The investigators were well aware of the possibilites of carnivore alterations of the faunal assemblages. They have addressed those possibilities, and their claim of human alteration at Old Crow seems valid despite their critics' objections. The same is true of expedient butchering tools on the Plains. The investigators have provided sufficient justification for their definition of expedient bone butchering tools. The main value of studies such as Binford's is to inject a substantial note of caution into the interpretation of fractured bones as tools.

Analysis of Formal Bone Tools

Formal bone tools are those artifacts which were intentionally modified from their original biological form. They are unmistakable as patterned artifacts, and have generally been analyzed as such. This aspect of modified bone research has made little use of faunal analysis or taphonomic models of bone assemblage changes. The following section will review some of these studies conducted in both the New World and the Old World.

New World

In the New World, the earliest work to focus on modified bone as formal artifacts was conducted in the Southwest. Early in this century, many of the largest and most spectacular ruins of the region were excavated by large expeditions. The density of artifacts in the huge sites of the Southwest is extreme, and the sheer quantity of materials forced the early investigators to construct organized analysis and tabulation frameworks for all artifact classes, including bone tools. Among the best known examples are the work of Frederick Hodge at Hawikuh (1920), Earl Morris at Aztec (1919), and in the La Plata District (1939), and Neil Judd (1954) at Pueblo Bonito.

The classic study though, and the one most cited today, is that conducted by Alfred Kidder (1932) on the artifacts from Pecos Ruin. As with so many of his contributions to Southwestern prehistory, this study has endured well beyond Kidder's era. He developed a classifications system for the Pecos bone tools which emphasized both morphology and element. For example, awls are divided into split and non-split categories and separated according to size and biological element.

Kidder (1932) also used ethnographic information in his classification wherever possible. The best example is that of weaving tools, which are long, slender implements resembling awls. They are highly polished with sharp points, and exhibit a series of closely spaced grooves near the point, oriented at right angles to the long axis of the tool. Kidder observed that they had originally been used in the Southwest during weaving to beat up the weft fibers. The prominent grooves were produced by friction against the tight warp threads (Kidder 1932:227).

Other ethnographic information has been applied to modified bone typology in the Southwest. During the late 19th century, bone awls were in common use among the Navajo. Their uses included piercing basket fibers and making holes in skins, while those with holes in their proximal ends were used for sewing with sinew thread (Kluckhohn et al. 1971:227). Awls were also employed in basketry, where they were used to manipulate the fibers during construction. They were superior to steel awls for this purpose, since they could part the fibers without injuring them (Mason 1902:246). Recently, ethnographic information regarding uses of bone tools was sought from elders in the Hopi villages of northern Arizona. They were shown bone awls excavated at the Anasazi cliff dwelling of Kiet Seel in Navajo National Monument, Arizona. The uses suggested included piercing hides, perforating basket walls for insertion of coiling strips, packing weft threads in weaving, separation of weft threads during weaving, and skewering ears of corn (Anderson 1969:134). These uses must be regarded with some caution, however, since there is a vast gulf between the 13th century occupation of Kiet Seel and the contemporary Hopi villages.

The preceding ethnographic information is generally specific to the Southwest. It is, however, instructive for modified bone analyses in the Middle Missouri, where the Plains Village occupation was also sedentary and dependent upon horticulture in a marginal environment.

Middle Missouri

The Middle Missouri is similar to the Southwest in some ways. The eariest investigations focused on enormous sites with very dense concentrations of cultural materials. It was necessary to construct an organized framework to deal with large numbers of artifacts, including bone tools. The typology was strongly oriented toward morphology and employed ethnographic information wherever possible. It was closely related to Kidder´s (1932) Pecos typology and was specifically acknowledged by some researchers in classification of bone tools (Wood 1967:89). The River Basin Surveys excavators used this system, as it represented the best bone tool typology available (Lehmer 1966, 1971; Smith 1977, Smith and Grange 1958; Wood 1967; Hoffman 1967, 1968; Krause 1972; Wood and Woolworth 1964; Woolworth and Wood 1964; Spaulding 1956; Caldwell et al. 1964; Neuman 1964; Calabrese 1972). Recent investigations in the KNRI area using this system were conducted at the White Buffalo Robe site (Falk et al. 1980). The use of a system similar to Kidder´s (1932) morphological bone tool typology was certainly valid, since Middle Missouri modified bone technology was extremely stable during the long Plains Village occupation.

Modified bone technology in the Middle Missouri began to change rapidly at the onset of Euro-American contact when metal tools became available. Most excavation reports dealing with sites from this period continued use of the prevailing modified bone typology, with appropriate description of metal modification and use of metal elements, such as iron knife blades (Lehmer et al. 1978). Notable exceptions to this pattern can be found in the work of Baerreis and Dallman (1961), Toom (1979). These investigations were carried out on Protohistoric sites in the Mobridge area and evaluated changes in modified bone technology within the wider context of the fur trade and the introduction of metal tools. Another departure from traditional Middle Missouri bone tool typology is the work of Moore (1985), which examines bone tools recovered at On-A-Slant Village from the perspective of independent variables such as morphology, function, technology, and use phase.

Old World

Modified bone studies in Europe have emphasized formal tools, especially in the recent literature. Very detailed morphological studies have been conducted, often in the context of constructing cultural chronologies. Lesser emphasis has been placed upon determination of tool function.

Most such studies have been conducted on tools from Magdalenian contexts, as bone tools from the earlier Aurignacian and Solutrean (where present) are generally sparse and consist almost entirely of hunting implements. The Magdalenian is much different. It is named for the rock shelter of La Madeleine in the Dordogne and flourished in the last stages of glaciation in Western Europe from ca. 18,000-11,000 B.P. (Champion et al. 1984:49). Using the Western European four part division of the Wurm glaciation, it begins during the Wurm III/IV interstadial and continues through Wurm IV. The appearance of the Magdalenian signals the beginning of a much greater functional diversity of bone tools. During this cultural period, the frequency of bone tools increases sharply, and many of them are decorated (Champion et al. 1984:56). Awls, needles, harpoons, wands, punches, and fish hooks all made their appearance, especially in the later stages of the Magdalenian.

The earliest analysis of Magdalenian bone tools was made by Breuil (1912, 1938) in an effort to subdivide the period. Breuil (1912) divided the Magdelenian into six stages. The earliest three are referred to as the Lower Magdalenian, while the later three are known as the Upper Magdalenian. Breuil utilized bone tools as the primary differentiating factors for the construction of his scheme. He defined "bone" to include objects of antler and ivory as well as bone. The Lower Magdalenian was dominated by javelin shaped sagai points with beveled bases and long bone wands or baguettes. The Upper Magdalenian exhibits a sequence of distinctive harpoons which progress in a rough sequence from crude proto-harpoons to elaborate harpoons with double rows of angular barbs. Breuil believed that these changes were regular and identifiable. In Magdalenian IV, there were harpoons with incipient barbs, in stage V, there were harpoons with a single row of well defined barbs, and in stage VI, harpoons with double rows of well defined barbs were documented. This scheme has been criticized as being too simplistic and for being based upon excavated materials with poor stratigraphic control. Reanalysis of the materials generally confirmed Breuil's work, but indicated that harpoon types are not clearly separated cultural markers (Laville et al. 1980:294-297).

More recent modified bone research has focused upon the replication of manufacturing techniques, and upon determining the tools used in manufacture (Clark and Thompson 1953; Newcomer 1974, 1977; Stordeur-Yedid 1979). Other studies have emphasized logical analysis systems for dealing with bone tool assemblages (Dewez 1974; Patou 1981), and detailed statistical analyses of Magdalenian bone tools collections have been undertaken (Fritz 1977). Fracture patterns of modified and unmodified bones have been studied (Leroi-Gourhan and Brezillon 1972) along with experimental studies of the characteristics of various raw materials such as bone, ivory, and antler (Albrecht 1972). Typological studies in the recent literature are more detailed than previous work, resulting in the definition of greater variability in Magdalenian bone tools than had been previously discovered using more traditional methodology (Deffarge et al. 1974).

The methodology of bone tool analysis in Europe has progressed considerably since Breuil´s original definitions of the Magdalenian. A variety of detailed techniques are now applied to bone tool assemblages in order to document greater variability than was previously possible.

Use Wear Analysis

Use wear analysis has been a major research topic in lithic studies for a number of years (Tringham et al. 1974; Keeley 1977).

This level of interest has not, however, resulted in major application of use wear analysis in modified bone studies. This section will examine use wear analysis, and its applicability to modified bone.

Lithic use wear analysis is very important for interpretation of prehistoric change in the collections from earthlodge sites in the KNRI. Lithic analysis at the three major villages, as well as at numerous other sites in the vicinity, is based upon work conducted by Ahler (1975). Ahler´s analysis system is based on extensive experimental replication and use of stone tools, resulting in description of manufacturing techniques and use patterns. This information is then used to derive a series of functional tool categories. Comparable studies have not been conducted for modified bone assemblages, making it impossible to derive similar functional tool categories. Experimental replication and use of bone tools similar to Ahler´s (1975) work with stone tools is beyond the scope of the present study.

Modified bone use wear analysis has been attempted, although not to the degree undertaken in lithic studies. In the New World, Tyzzer (1936) was among the earliest to work with wear patterns on bone tools. He examined a very common tool category, that of simple bone points from shell heaps in the northeastern United States. He examined wear patterns, and conducted archery experiments in order to derive experimental analogs. On the basis of this research, he concluded that the bone points had functioned as projectiles. More recently, use wear information has been employed in the definition of expedient bone butchering tools. The tools are defined not only on morphology, but also on the basis of characteristic wear on the working edge (Frison 1974, 1978; Johnson 1982).

The only example of use wear studies on bone tools from the Midwest is that of Chomko (1975) at Arnold Research Cave in Missouri. He worked with bone awls and antler tines from the cave in an attempt to derive patterns of use within traditional tool types from wear patterns left on the tools. No attempt was made to determine actual tool function or use. In the KNRI area, Moore (1985) has conducted use wear analysis of bone tools from On-A-Slant Village. She was able to derive a functional classification of the tools based upon microscopic examination of wear patterns.

The classic study of modified bone use wear is that undertaken by Semenov (1964). He conducted microscopic analysis of European bone tools in order to derive both manufacture processes and tool use. He established a series of manufacture procedures and tool uses from microscopic striations. However, as pointed out by Bonnichsen and Will (1980:19), many of Semenov´s statements are inferential, and will require further testing in order to be useful in prehistoric studies. Semenov´s work was never really followed up with any systematic body of analyses in the literature. This may be due to the relatively soft nature of bone, which is easily damaged under the impact of taphonomic processes such as biological and geological alterations (Fig. 11). Microscopic analyses of use wear are therefore difficult to undertake. Another factor is the lack of substantial experimental analogs, such as have been developed for stone tools, which makes detailed modified bone use wear analysis very difficult. For these reasons, use wear analysis will not be attempted in the present study.

Bone Tool Analysis For This Study

Bone tool analysis in the KNRI will focus on formal artifacts, in a setting where human habitation is not in doubt. Some expediency tools are present, but they will not be used as the sole determinant of human occupation. As discussed above, modified bone technology in the Middle Missouri was extremely stable for a very long time. The only period during which major technological change occurs in modified bone assemblages is during Euro-American contact. The KNRI villages present a unique opportunity to examine modified bone in this context.

One of the first considerations in analysis is tool typology. As discussed above, an extensive bone tool typology has been developed for the Middle Missouri, originally based on Kidder's (1932) research at the Pecos ruin. Changes were made, based upon regional variations in tools, and upon available ethnographic information. For the purposes of this study, the established typology will be used, but function will only be assigned when based upon ethnographic information, especially that supplied by Hidatsa informants (Wilson 1917). Determination of function on the basis of use wear analysis will not be attempted. There is no substantial body of experimental analogs upon which to base bone tool use wear determinations, and a systematic program of experimental manufacture and use of bone tools is beyond the scope of this study.

The primary focus of the present work will be on how bone tools were manufactured, not how they were used. The distinction between manufacture with stone tools versus metal tools is of considerable significance. Another major focus is on the composition of the tool assemblage, and how it changes through time as metal tools are introduced.

Measurement systems for bone tool analysis have been developed and implemented, especially in Europe. A good example is Julien's (1982) extremely detailed study, focusing entirely upon Magdalenian harpoons. In this country, a simpler bone tool measurement system has been proposed by Bonnichsen and Will (1980:27-30). Their system is based upon a systematic series of points and lines, yielding a metric quantification of artifact morphology. Measurements will not be performed on the KNRI bone tools in this study. For the vast majority of KNRI tools, measurements would essentially be determined by the biological size of the faunal element making up the tool, and hence be of little value in the analysis. The biological size of tool elements would not be a relevant factor in reference to the study goals.

The following goals will be pursued in the analysis. First is the determination of changes in manufacturing techniques as contact progressed, especially with reference to the shift from stone to metal tools for bone tool manufacture. Second is the examination of changes in assemblage structure as bone tools are replaced with metal substitutes. These goals will be pursued within the detailed chronological framework at each site developed through archaeological and ethnohistorical analysis. Ultimately, the intent is to construct a general model of acculturation as reflected in bone tool assemblages that might be of use in other areas where documentation is not as complete.

Models of Prehistoric Change

Models constructed to aid the explanation of prehistoric change have become common in the recent literature. Some models are explicit and clearly formulated, but most are implicit and never fully discussed. This section will examine how models have been defined in the literature and present examples of how they have been used. It will conclude with a discussion of models used in this study, both implicit and explicit.

In the definition of models, the name of David Clarke comes to mind more than others, as he worked extensively with the definition and use of models in archaeological research. He defines models as pieces of machinery relating observations to theoretical ideas. Often, they are only partial representations, or convey essential ideas which largely account for observed variability (Clarke 1972a:1-2).

The importance of understanding models is considerable. Clarke sees archaeologists as being controlled in their investigations by largely subconscious models. These controlling models can thus restrict choices of operational models with which to use with archaeological observations (Clarke 1972a:3-5). Clarke (1972a) then goes on to describe detailed criteria for the construction and implementation of operational models. It is safe to say that few actual studies of archaeological data achieve the rigor of model construction and use outlined by Clarke. This is not to say that models are not useful in archaeological interpretation, but only that, by Clarke´s standards, most are fairly simple representations.

Numerous examples of models in use can be found in the literature, especially in a classic volume edited by Clarke (1972b). The use of implicit or controlling models has guided much of the description and explanation of prehistoric cultural change. This is true even of the older literature in the Middle Missouri, where implicit models of diffusion and coalescence of traits can be detected. Most models in the literature are of this nature, in that they are relatively straightforward abstract concepts which aid in the explanation of extinct cultural phenomena (Jochim 1976). Much more sophisticated models of cultural change, grounded in mathematical theory have been developed. These materials have primarily been developed by archaeologists in Great Britain (Clarke 1972b, 1979; Renfrew 1973, 1979). In addition, collected volumes of such works have been published (Renfrew and Cooke 1979; Renfrew et al. 1982). Most of the models at this level of complexity have not seen actual application. Notable exceptions would include the work of Keene (1979, 1981), who developed an extensive linear programming model of Late Archaic hunter-gatherer populations in southern Michigan. Another example would be Reynolds´ (1976) development of a Markovian model to explain linear settlement patterns along the upper Grijalva River in Chiapas, Mexico.

Systems Theory

The use of systems theory has been of major interest in archaeology since the 1960´s. Among the best known initial formulations are those of Clarke (1978) in Great Britain, and Binford (1965) in this country. Systems theorists envision culture as a system, composed of interrelated subsystems (Watson et al. 1984:71-77). These subsystems have the capability to react to their environment, and regulate their processes through feedback. Negative feedback systems are those in which change is kept at a minimum so that their states remains stable. Positive feedback systems, on the other hand, are those in which change tends to amplify and move the system to a new state. Some systems can be characterized as being in a state of equilibrium, where the system will return to its original state, despite input from the surrounding environment. Numerous studies based upon systems theory are present in the recent literature (Flannery 1968; Hill 1977; Plog 1977) and simulation of systemic change has been undertaken by Cooke and Renfrew (1979) in dealing with Aegean cultural systems.

There is some confusion in the literature regarding systems theory terminology. The studies described above have employed a useful technique in the explanation of prehistoric change. However, it should be referred to as a systemic approach instead of a systems theory approach. General Systems Theory is based upon rigorous mathematical models, and is not really usable for archaeological data. Archaeologists are not yet able to characterize archaeological systems with sufficient precision to make use of existing General Systems Theory mathematical models (Salmon 1978; Watson et al. 1984:102-111).

Middle Range Theory

Middle Range Theory has been presented and debated in the recent archaeological literature. Middle Range Theory was originally defined in sociology as an approach to theorizing which attempted to consolidate high-order theories with low-order empirical studies (Raab and Goodyear 1984). The archaeological use of Middle Range Theory was introduced by Binford (1977) as a body of theory to be used in going from static objects in the ground to the dynamic cultural systems which deposited them. Similar definitions have been presented by Thomas (1979:398) and Willey and Sabloff (1980:249-254). As such, the archaeological definition of Middle Range Theory is more narrowly defined than the sociological definition, focusing almost entirely upon site formation processes. Raab and Goodyear (1984:262-263) believe that theory building is hampered by equating Middle Range Theory with site formation processes which have been investigated under other theoretical names in the past. They do, however, believe that some Middle Range

Theory construction is underway, with the potential for contributing to the explanation of prehistoric change.

Formal application of Middle Range Theory is more difficult to find than is discussion of its merits. Binford's work with Nunamiut hunting camps (1980) and faunal assemblages (1981) discusses Middle Range Theory and may in fact be an example of its use. Binford (1981:191) cites Brain's (1969) work with Hottentot faunal assemblages as a classic example of middle range research. Raab and Goodyear (1984) also cite some examples, but it is safe to say that Middle Range Theory has seen more discussion than application.

Models in the Middle Missouri

Implicit or controlling models have played an important role in shaping archaeological inquiry in many areas, including the Middle Missouri. The bulk of research in the Middle Missouri was undertaken by the Smithsonian Institution's River Basin Surveys as salvage archaeology in advance of reservoir construction. Much of the work is descriptive in nature, and geared toward the construction and refinement of cultural chronologies. Even so, implicit models of prehistoric change are evident, the most obvious of which is an implicit model of diffusion. This is especially evident in the work of Lehmer (1954a, 1954b, 1970, 1971). His descriptions of cultural interactions in the Middle Missouri stress population movements and conflicts as being responsible for settlement patterns. This is based upon an implicit diffusionary model, whereby the movement of peoples and traits are responsible for prehistoric change. Bowers´ (1950, 1965) model of cultural and ethnic change in the upper Middle Missouri is another example of research which is strongly rooted in an implicit model of diffusion.

Since the filling of the reservoirs in most of the Middle Missouri valley, the pace of research has slowed. Most recent work has been done in a cultural resource management framework and continues to stress chronology building, in a manner similar to the River Basin Surveys. There are some notable exceptions such as Deetz´s study (1965) in which pottery design elements are employed to reconstruct social organization, and Ahler (1975), in which sophisticated statistical procedures are employed in analysis of lithic collections in order to recognize patterning and make inference regarding social structure. The systemic approach as described above has been employed in the Middle Missouri. An example is Wood´s (1974) research in which he described Plains Village society in a systemic framework as existing in stable equilibrium with its environment.

Another implicit model is that of cultural evolution. The River Basin Surveys research is primarily descriptive, but it does contain an implicit model of cultural evolution, or increasing cultural complexity through time. At the same time, the New Archaeology of the 1960´s was certainly grounded in cultural evolution, as a stated research goal (Willey and Sabloff 1980:187). However, Michlovic (1983) argues that cultural evolution is not an appropriate model for the northern Plains. He notes that the Plains contain a hunting and gathering lifeway of long duration. The prominent horicultural lifeway of the river valleys did not evolve in place from hunting and gathering populations, but was introduced up the major river valleys from the Eastern Woodlands. This point is well taken, but may face an exception in the KNRI area where the presence of a substantial Plains Woodland occupation in the valley breaks might have provided an indigenous pre-Plains Village population which evolved in place to form at least some of the later Plains Village horticultural populations.

Models For This Study

The models used in this study are generally simple constructions, certainly not up to the complexity and rigor of those proposed by David Clarke. The systemic approach will be applied here, in the form of an important outgrowth which recognizes the factors by which artifacts pass through functioning cultural systems, often in several recycled forms, and ultimately into the ground (Schiffer 1972, 1976). The variable to account for these processes is use phase, and will be described in detail in a later section.

Diffusion has been used already as an implicit model, providing structure for the discussion of tribal movements, especially those rooted in tribal oral history. Cultural evolution is also employed as an implicit model underlying much of the research, suggesting that the earliest groups in the area increased in cultural complexity prior to contact with Euro-Americans.

The most important explicit model is that of acculturation. This model will be used to structure much of the current research. It has been described in detail in a previous section, and will be used to describe changes in modified bone technology at Euro-American contact with the hope of discovering regularities which might be applicable to other areas.

MODIFIED BONE ANALYSIS FOR THIS STUDY

In this study, the analysis of bone tools has been designed so as to document variation in manufacture techniques and assemblage structure during Euro-American contact. Major changes occurred during the process of contact as a diverse, well developed native bone technology was largely replaced by Euro-American substitutes. The variables chosen for analysis are those believed to reflect the most important changes. These include changes in bone tool manufacture strategy as metal tools became available, and changes in assemblage structure as bone tools were replaced with metal substitutes.

This chapter will describe the procedures used in analysis of modified bone assemblages from the KNRI villages, with reference to other modified bone analyses as described above. First, the procedures by which bone tools were separated from all other unmodified faunal materials will be discussed. This will be followed by a description of specific processing procedures followed for assemblages from each of the three KNRI villages. The variables recorded for each tool will then be discussed, followed by a description of all individual tool types.

Initial Tool Separation and Processing

Processing of cultural materials from the three KNRI villages has been described in detail in an earlier chapter. The first step was to size grade all water screen debris returned from the field.

The resulting materials were then separated into their constituent classes. All faunal materials were removed from size grades 1-3, while only identifiable and modified bone was removed from grades 4 and 5. All resulting faunal materials were packed and shipped to Mr. Carl R. Falk in Sevierville, Tennessee. Falk and his staff conducted all further faunal analyses and produced technical reports describing their findings. The procedures followed to separate and process the modified bone assemblages will be described here.

When Falk and his staff received the faunal materials from the University of North Dakota, they were processed according to a highly structured system. When analysis was complete, all modified bone had been separated, and taxonomic identifications were attached to all identifiable unmodified bone. The only cleaning performed was that undertaken during field water screening, and the bones were not washed during processing, as this tends to hasten deterioration. No preservatives were used, other than a glue and water solution applied to some of the more friable bones during initial processing at the University of North Dakota.

Upon receiving the size graded faunal materials, the initial step was to weigh the contents of each size grade. The materials were not counted, as this was seen as too time consuming, with a minimal return of useful information. The first sorting process separated burned from unburned fauna. Modified bone was removed at this time. Next, the material was examined again, and identifiable bone was separated from unidentifiable bone. Identifiable elements are those exhibiting an articular facet which can be identified as to side. A few more modified bones were found during this second sorting process. The modified bones were then set aside, and the unmodified, unidentifiable bone was placed in dead storage.

During subsequent processing of identifiable fauna, bison bone was separated from non-bison bone, and the non-bison taxa were identified with the aid of comparative collections. During this process, a few more bone tools were identified and removed. A good example of a modified bone category removed during this third sorting process would be perforated fish vertebrae. They were originally removed at the University of North Dakota from size grades 4 and 5 as unmodified, identifiable bone. Grades 4 and 5 were sorted in North Dakota, prior to any examination by Falk and his staff. It is inevitable that a few small items such as awl tips escaped detection during this sorting process. During faunal processing in Tennessee, modified bone was removed during three separate sorting procedures by experienced laboratory personnel. It is unlikely that any significant number of bone tools escaped detection.

Falk and his staff also conducted analysis of modified bone materials, prior to transferring them to the author for this study. Their analysis procedure consisted of recording information on a single sheet of paper for each specimen. The tool was described, identified as to taxon and element, and classified as to method of manufacture. Traditional tool typology for the Middle Missouri subarea was employed, and each specimen was examined both macroscopically and microscopically. A systematic functional evaluation was not attempted, for the same reason it is not attempted here. There is no systematic experimental data base from which to make functional evaluations on the basis of wear patterns. The descriptive modified bone categories derived during analysis in Tennessee are being used by Carl Falk as part of a synthesis of faunal materials from the KNRI. It will be included in the final comprehensive synthesis of the KNRI Project results, now underway.

Characteristics of Site Assemblages

The modified bone assemblages from the three sites were separated from unmodified fauna over a long period of time, as field research was progressing in the KNRI. As a result, there were some differences in separation procedures, most related to personnel. As these differences may have had some effect upon the consistency of modified bone sorting, they will be described here.

The modified bone assemblage from Lower Hidatsa (32ME10) can be assigned the highest level of confidence. All of the work was done by Carl Falk in a consistent manner as described above. Much the same can be said for the assemblage from Big Hidatsa (32ME12), which is by far the largest of the three. The bone tools were separated according to the procedures outlined above by an experienced member of Falk's staff, under his direct supervision. The bone tools from Sakakawea (32ME11) are a different case. As discussed in earlier sections, much of the field work at Sakakawea and analysis of collections was conducted prior to the beginning of the Knife River

Project. As a result, the initial modified bone separation procedures were not carried out under Falk's direction and the Sakakawea materials are considered to be less reliable than those from the other two villages. At this juncture, there is no way to know how many bone tools may have been excluded from the Sakakawea collection, but it is not believed to be a significant number.

The author had no direct involvement in the separation of bone tools from unmodified fauna. This disadvantage is offset by his direct involvement with field work in the KNRI and initial laboratory processing at the University of North Dakota. In addition, the bone tool separation was accomplished by an experienced staff under Carl Falk's direction. The author had the opportunity to travel to Tennessee, and confer with Falk at his laboratory. During that visit, the author examined the bone tools, as well as samples of those bones classified as unmodified. It was concluded that the bone tool separations were done in a careful, consistent manner by experienced specialists, and that the results can be confidently used in this analysis.

Variables Employed In This Analysis

A number of variables have been recorded for each specimen. All are nominal level, and have been coded for manipulation with the SPSS-X computer-based statistical package (Nie et al. 1983). All computations were performed on the mainframe computer system at the University of Kansas Computer Center. No measurements were taken, for reasons outlined above. SPSS-X is therefore employed primarily for expedient crosstabulation, and for generation of nominal level statistics as deemed appropriate. The tool-specific variables recorded for analysis are tool type, use phase, metal/stone modification, and predominant manufacture strategy. All other variables are related to provenience, such as site, area, excavation unit coordinates, excavation level, horizon, feature, and time period (Table 9). This section will describe the tool specific variables used in analysis.

Tool Type

Certainly one of the most important variables in this analysis is tool type, and the established tool typology for the Middle Missouri subarea is employed. This typology is based primarily upon biological element and morphology, and is similar to that originally developed at Pecos ruin in New Mexico (Kidder 1932). The tools are grouped as to element, so for example, scapula tools constitute a category separate from rib tools. Little can be accomplished with examination of differences in species use, since virtually all of the Knife River bone tools are made from bison bone.

The tool types used here are essentially descriptive. For reasons discussed above, no attempt has been made to assign function unless this could be done with ethnographic information. Examples of this type of tool would be scapula hoes and squash knives, which are relatively secure in functional assignment. Other categories with less secure functional assignment, such as bone spatulas, are

Table 9. Summary of bone tool variables and associated column numbers as coded for manipulation with the SPSS-X computer-assisted statistical analysis package.

Variable Label	Column
Site Designation	1-2
Site Area	4-5
Component	7
Horizon	9-10
House Area	12
Feature Number	14-16
Feature Type	18
Containment	20
Recovery Procedure	22
Test Unit, North Coordinate	24-26
Test Unit, West Coordinate	28-31
Archaeological Context Unit	32-33
Catalog Series	35
Catalog Number	37-39
General Tool Category	41-42
Specific Tool Type	41-43
Metal/Stone Modification	45
Use Phase	47
Predominate Manufacture Technique	49

presented as descriptive categories along with functions that have been suggested in the literature. This is not seen as a problem, since as previously discussed, the manner in which tools were made and the total assemblage composition is much more important for present purposes than how they were used. The other variables recorded are designed to answer those questions. A detailed description of all tool types will be presented later in this chapter.

Use Phase

Use phase is a very important bone tool variable. It is based on Schiffer's (1972, 1976) concept of systemic context. This refers to an artifact's position in the prehistoric cultural system prior to its discard into the archaeological context. This concept was used by Ahler (1975) to construct a variable called "use phase class", in order to group artifacts which shared common systemic context when deposited into the archaeological record. This variable has been used extensively in lithic analyses at sites in the KNRI and immediate vicinity. Lovick's (1980) analysis of the stone tools from the White Buffalo Robe site is a good example. Use phase has seen much less application in modified bone analyses. One of the few instances where it has been employed is during analysis of the modified bone assemblage from On-A-Slant Village (Moore 1985:41-42).

In this analysis, use phase is used to provide a measure of bone tool fragmentation, stages of manufacture, and degree of recycling. Table 10 provides a description of use phase categories as applied to the present study.

Metal/Stone Modification

The type of tools used in the manufacture of bone tools is very important in the determination of prehistoric change during Euro-American contact. Metal tools introduced through the fur trade were almost entirely iron, which has not preserved well in the village deposits. The presence of metal must, in most cases, be inferred from the marks left on bone tools. The presence of metal cut marks on bone is one measure of the time at which the Hidatsa became a part of the fur trade system, and as such is very important.

The determination of metal or stone manufacture on the basis of cut marks on bone tools can be very difficult. In general, metal tools leave narrow cuts with sharp, distinct edges while stone tools leave wider cuts with sloping, ragged edges. A metal blade will cut cleanly with a minimum of strokes, while a stone blade will cut more slowly and require many more strokes. Examples of cuts interpreted as having been made by metal and stone tools are illustrated in Figure 12. The examples provided are, of course, ideal representations. There is a substantial gray area of cut marks which could have been made with either metal or stone tools. During analysis, cut marks were conservatively coded as having been made by metal or stone tools. Only those cases which were fairly clear were assigned as such. The majority of tools have been coded as having

Table 10. Summary of use-phase class definitions used in analysis of bone tools from Lower Hidatsa (32ME10), Sakakawea (32ME11), and Big Hidatsa (32ME12). Adapted from Lovick (1980:273 Table 9.13).

Use-Phase Class	Definition
1	Complete, unfractured blank, preform, or other partially manufactured artifact (potentially functional items).
2	Unfinished artifacts broken or rejected during manufacture (non-functional items).
3	Complete, unfractured, non-exhausted, technologically finished artifacts (functional items).
4	Technologically finished artifacts, broken during use, broken during resharpening or recycling, or exhaused from use and/or recycling (non-functional items)
5	Recycled artifacts, utilized after breakage (functional items).
6	Expedient bone artifacts, unmodified except for breakage and use (functional items).

Figure 12. Bone tools from the Knife River villages exhibiting cut marks made with stone and metal tools. a-b: bone tools modified with stone tools; c-d: bone tools modified with metal tools.


a
c
b
d
c m

indeterminate metal/stone cut marks.

Other researchers have provided definitions of metal and stone cut marks on bone. Binford's research among the Nunamiut focused on bones which had been butchered with metal tools. This makes comparision with bones in archaeological sites butchered with stone tools somewhat difficult. In the Nunamiut assemblages, it was observed that metal cut marks are very thin, or almost hairline in size. A shelf of bone is often left, leaving the cuts difficult to discern when looking straight down (Binford 1981:105). The metal cuts are generally long, resulting from cuts across tissues. Cutting with stone tools, on the other hand, is accomplished with shorter, parallel strokes. Stone tools are thicker, and do not have a single smooth cutting edge. As a result, the cuts tend to be short, and have a more open cross section and ragged appearance than those produced with metal tools (Binford 1981:105). Binford's examples of metal cut marks are more convincing than those from the KNRI. The Nunamiut use sharp, modern steel knives, while the Knife River Hidatsa were using iron knives which were probably not nearly as sharp. The resulting cuts are more ambiguous than those presented by Binford.

These criteria for determining metal and stone modification are obviously not rigorous or quantifiable. There have been some attempts to quantify metal and stone cut marks though controlled experimentation. The best example is the work of Walker and Long (1977). They conducted controlled experiments of bone cutting, using both metal and stone tools. Casts were then taken of the cuts, and examined microscopically in cross section. Distinct differences were observed between cuts produced by metal and stone tools. This difference is especially noticeable when cuts made with bifacially flaked tools are compared with those made with steel knives. Differences were less pronounced when obsidian flakes were used. Research such as this is beyond the scope of most studies, including the present one.

The problem in differentiating metal from stone cuts on bone is similar to that faced when dealing with use wear analysis. There is no systematic body of experimental literature dealing with types of cut marks on bone. Walker and Long's (1977) study is almost alone in its approach. Therefore, in the present study, metal/stone determinations are made primarily on the basis of macroscopic identification, supplemented by examination under a 10x binocular microscope. Similar procedures were employed by Moore (1985) in differentiating between metal and stone modification on the bone tools from On-A-Slant Village. No use has been made of scanning electron microscope information, or microscopic cross-section information such as that used by Walker and Long (1977). The approach taken during analysis for this study is considered to be sufficient for detecting most clear instances of metal and stone modification. The information gathered in this manner will be compared with frequencies of metal scraps and trade materials in deposits from the three villages.

Predominant Method of Manufacture

The final tool-specific variable is predominant method of manufacture. This variable records the major procedure by which any given tool is manufactured from unaltered bone. The first category is that of scoring and splitting. In this procedure, grooves are scored in the bone´s surface, parallel to the grain, and the area between the grooves is pried out. This results in thin pieces of bone, well suited to the manufacture of piercing tools such as awls. This procedure has been described in detail as "groove and splinter" by Clark (1971) at the English site of Star Carr. It has been employed to describe bone tool manufacture tecniques at villages in the KNRI area, especially at On-A-Slant village near Bismarck (Moore 1985).

The second major category is chopping/grinding. This procedure is especially evident in the manufacture of bison scapula hoes. The tools are manufactured by chopping the vertebral spine and posterior border away, and grinding other areas of the bone, sometimes including the coracoid process and glenoid fossa.

The third major category of manufacture is that of breakage. Tools placed in this category are modified only by breakage. The obvious example of such tools is that of expedient butchering tools, which are generally made from bison long bones.

These categories are employed in an effort to determine if significant changes in manufacture strategy occured during Euro-American contact. All possible manufacture strategies are by no means represented here, but the major ones are and changes in them will be discussed in a later chapter.

Description of Tool Types

The established bone tool typology for the Middle Missouri subarea has been utilized for this study of 894 modified bone items recovered from the three villages. All tools are made from bison bone unless otherwise indicated. They are grouped first by biological element, with functional assignment made wherever possible on the basis of ethnographic information. Table 11 provides a summary of the general tool categories identified during analysis. Rib and scapula tools are prominently represented in the collection, and were obviously very important in native bone technology, representing 46% of the collection or a total of 413 items (Table 11).

The general tool categories presented in Table 11 are useful for broad presentation of assemblage characteristics, but allow little discussion of changes through time. A series of more detailed tool types was thus constructed, allowing examination of changes within biological elements, such as rib tools (Table 12). The 41 tool types constitute one of the most important variables for analysis of modified bone in the KNRI villages. The remainder of this chapter will describe the tool types presented in Table 12.

Rib Tools

Ribs are plentiful bones in bison skeletons. They are quite

Table 11. Summary of general bone tool categories used in analysis of assemblages from Lower Hidatsa (32ME10), Sakakawea (32ME11), and Big Hidatsa (32ME12) villages.

General Tool Cateogories	Frequency	Percentage
Split Ribs	62	6.9
Slotted Ribs	26	2.9
Perforated Ribs	15	1.7
Dorsal Spines	3	0.3
Scapula Tools	310	34.7
Antler Tools	80	8.9
Awls	33	3.7
Tubes/Beads	75	8.4
Expedient Tools	87	9.7
Horn Core/Frontal Tools	2	0.2
Fleshers	13	1.5
Cancellous Tools	11	1.2
Fish Hooks	7	0.8
Manufacturing Debris	43	4.8
Polished Fragments	101	11.3
Ochre Stained Bone	3	0.3
Ornaments	8	0.9
Unique Objects	15	1.7
	894	100.00

Table 12. Summary of specific bone tool types used in this study.

Tool Types	Frequency	Percentage
Split Ribs	61	6.8
Split Dorsal Spines	1	0.1
Slotted Ribs-Unknown Blade	4	0.4
Slotted Ribs-Metal Blade	20	2.2
Slotted Ribs-Stone Blade	2	0.2
Perforated Ribs	15	1.7
Dorsal Spines	3	0.3
Scapula Hoes	65	7.3
Scapula Knives	19	2.1
Scapula Hide Wringers	8	0.9
Scapula Spines	14	1.6
Scapula Fragments	204	22.8
Antler Tines	24	2.7
Antler Beams	5	0.6
Antler Strips	10	1.1
Antler Needles	4	0.4
Antler Debris	36	4.0
Antler Ice Gliders	1	0.1
Awls	10	1.1
Metapodial Awls	5	0.6
Rib Awls	5	0.6
Splinter Awls	12	1.3
Scapula Awls	1	0.1
Tubes/Beads	1	0.1
Complete Tubes	42	4.7
Split Tubes	28	3.1
Whistles	1	0.1
Perforated Fish Vertebrae	3	0.3
Expedient Tools/Shaft	30	3.4
Expedient Tools/Articular	9	1.0
Expedient Tools/Rib	47	5.3
Expedient Tools/Scapula	1	0.1
Horn Core/Frontal Tools	2	0.2
Fleshers	13	1.5
Cancellous Tools	11	1.2
Fish Hooks	7	0.8
Manufacturing Debris	43	4.8
Polished Fragments	101	11.3
Ochre Stained Bone	3	0.3
Ornaments	8	0.9
Unique Objects	15	1.7
	894	100.00

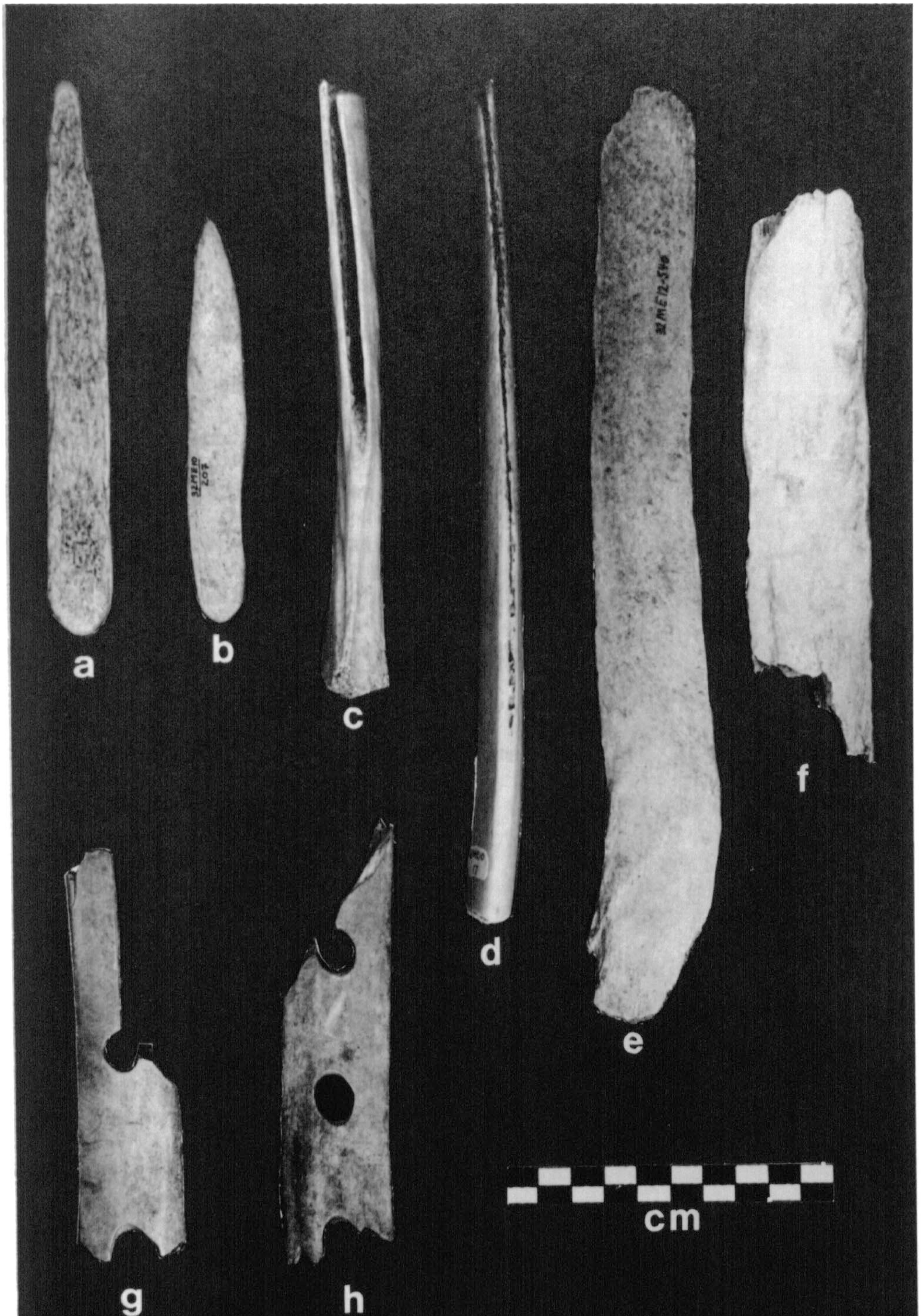
long, are relatively flat in cross section, and have a gentle curve from end to end. Their morphology makes them an ideal raw material for a variety of bone tools. Dorsal spines are occasionally used for similar tasks, but are readily distinguishable from ribs. They are larger in cross section, and are quite straight. Dorsal spines attached to the thoracic vertebrae of an adult bison are very large, as they form the foundation for the animal's prominent hump. All varieties of rib and dorsal spine tools in the KNRI collections will be discussed in this section.

Split Ribs (Spatulas)

Split ribs, or spatulas, are manufactured by longitudinally splitting a short section of rib. One side of the tool is the bone's exterior, while the other is the cancellous bone interior (Fig. 13). The cancellous bone is ground and smoothed, from use as well as during manufacture. The ends are intentionally rounded and beveled, and often exhibit battering, pitting, and striations from use. Spatulas are very common tools in Middle Missouri Plains Village sites, and their suggested functions include quill flatteners, pottery modeling tools, and pressure flakers.

Their function as quill flatteners was suggested by Wedel (1955:125-126) and Lehmer (1954b:67). In traditional quillwork, porcupine quills are softened by soaking in water, and then flattened prior to use. It has been suggested that the tips of bone spatulas were used to flatten the quills. They were then sewn onto

Figure 13. Rib tools from the Knife River villages. a-b: split ribs (spatulas); c: knife handle slotted for a stone blade; d: knife handle slotted for a metal blade; e: split dorsal spine; f: utilized dorsal spine; g-h: perforated ribs.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leather garments in elaborate designs, with the tips sewn into the leather, where they would not show. This traditional art form was replaced by the introduction of glass beads through the fur trade. Elaborate beadwork soon followed and continues today among many tribes on the Northern Plains.

It has also been suggested by Wheeler (1954:18) that bone spatulas functioned as pottery modeling tools. Wheeler's limited experimentation suggested that bone spatulas are quite suitable for incising and trimming pottery during manufacture. The marks left on the experimental pottery vessels were identical to those found on prehistoric pottery from Plains Village sites.

A third possible function for bone spatulas is that they served as pressure flakers during the manufacture of chipped stone artifacts. This is suggested on the basis of artifacts recovered at the Hagen site (Mulloy 1942:66-70), the Jake White Bull site (Ahler 1977:109), and the Mondrian Tree site (Falk 1983:14.7), among many others. The argument for classifying spatulas as pressure flakers rests on the fact that the blunt ends of the tools are often scarred and pitted, rather than smoothed suggesting impact with a hard substance (Ahler 1977:109).

No definitive assessment of function can be attempted for these artifacts. All three of the possibilities discussed above are plausible, but in the absence of substantial systematic experimental analogs, no final determination can be made.

Split Dorsal Spines

Bison dorsal spines are often used to make the same types of tools as those made with bison ribs. Split dorsal spines are somewhat similar in appearance to split ribs, but they are straighter, and are larger and thicker (Fig. 13). It is assumed that they performed much the same funtions as split ribs.

Slotted Ribs (Knife Handles)

These tools were manufactured by cutting a slot in the side of a section of a bison rib, or more rarely, a dorsal spine. A blade or cutting element was then forced into the slot, with the bone functioning as a handle. Prior to Euro-American contact, these handles held stone blades, judging primarily from the width of the remaining slot. After metal became available through the fur trade, thin metal blades were forced into correspondingly narrow slots in the handles (Fig. 13). The determination of element is not entirely based upon the width of the handle slot. Although no stone or metal blades were found in the handles recovered from the KNRI villages, blades in place have been found at other sites. For example, three bone handles with metal blades in place were found at Talking Crow (Smith 1977:108), as well as at the Deapolis site, just downstream from the KNRI (Lehmer 1971:146-147). One bone handle from On-A-Slant village near Bismarck was recovered with a stone blade in place. It is noteworthy because the stone blade consisted of a lanceolate projectile point, inserted into the bone handle so that one corner of the butt served as the point of the knife (Strong 1945). All but one of the knife handles from the KNRI collections could be classified as to blade element on the basis of slot width.

These tools are invaluable for assessing technological change during Euro-American contact, as they can be clearly associated with either stone or metal blade elements. Unfortunately, they are relatively small in number (26). For the most part, determination of the introduction of metal tools will rest primarily with interpretation of cut marks on bone, using the definitions discussed above.

Perforated Ribs

These tools are segments of bison ribs, with distinct, well-worn holes bored through them (Fig. 13). Sometimes only one hole is present, but more often, the tool contains several. They are common in Plains Village sites, and have been recognized throughout the Middle Missouri (Lehmer 1971:91). They have been interpreted as arrow shaft straighteners, and are often referred to as "shaft wrenches". It is believed that they were held at an angle to the arrow shaft, and vigorously worked up and down it, in order to straighten bends which might cause the arrow to miss its target. This interpretation is bolstered by the fact that the holes are worn all around the edges, and even assume an oblong appearance in some cases. This certainly seems to be a reasonable interpretation, but there is no ethnographic evidence for the use of these artifacts to straighten arrow shafts. In many ways, these tools have entered a "folk taxonomy", where everyone knows what they are, but nobody knows the source of the original functional definition.

Utilized Dorsal Spines

These tools consist of segments of bison dorsal spines, with no identifiable manufacture pattern (Fig. 13). They do show evidence of use, in the presence of polish, especially along the edges. As such, they fit the general definition of beamers (Smith 1977:109). In all hide processing, the hide is rubbed with some sort of tool while laced into a frame. This stretches and softens the hide and makes it more usable. Beamers are thought to have been used for this process.

Scapula Tools

Scapula tools were a very important aspect of modified bone technology in Middle Missouri Plains Village sites. The importance of gardening to village subsistence has been discussed above, and scapula tools provided the raw materials for agricultural tools in the form of scapula hoes and knives (Wilson 1917). Given the importance of scapula tools to gardening, green bison scapulae would certainly have been quite valuable. Their value was probably enhanced by their comparatively short supply, when compared with other more plentiful elements such as ribs and long bones. Green scapulae are very durable bones, although this can be hard to remember when dealing with dry, friable bone tools such as those in the KNRI collections. Their durability made them well suited to the demands of garden tillage.

Scapula Hoes

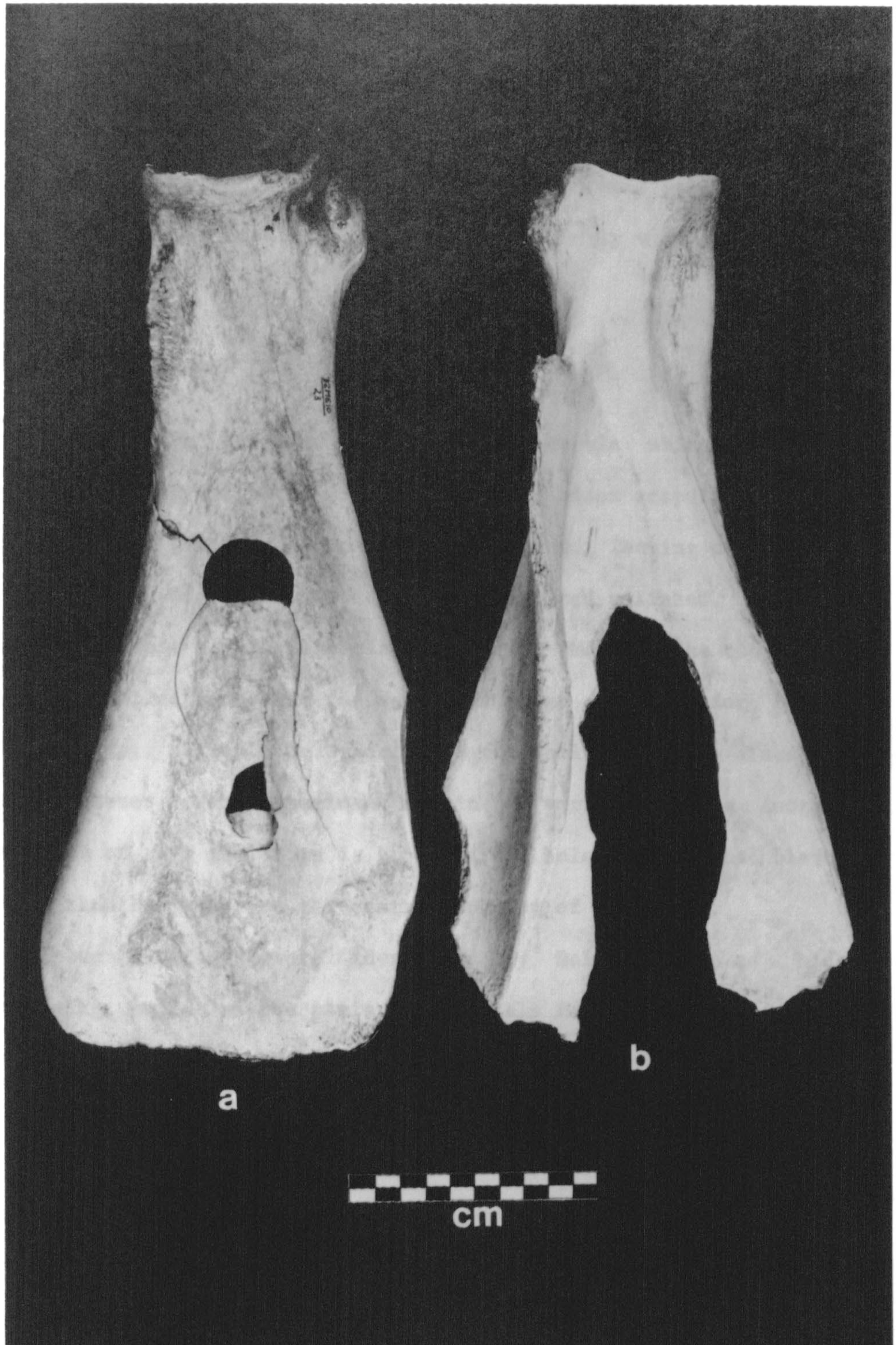
Scapula hoes are the most ubiquitious of all Plains Village bone tools. They are found in virtually all excavated Middle Missouri Plains Village sites (Lehmer 1971). These tools, along with digging sticks and antler rakes, formed the basic gardening implements of the horticultural peoples of the Plains, one of the two major Plains lifeways (Holder 1970).

Perhaps the best description of their use is that provided by Buffalobird-woman. The connection is especially direct in this case, since she was recalling events relating to the Knife River villages, where she was born two years after the smallpox epidemic, or about 1839 (Wilson 1917:4). She was about 73 years old when Wilson began his field work at Fort Berthold in 1912. She recalled that iron hoes had come into common use when she was a girl at Like-A-Fishhook village, but that two or three old women, including her grandmother, still used bone hoes (Wilson 1917:105). Her descriptions of bone hoes and other tools were thus related late in life, drawing on childhood memories of implements which even then had all but passed from use. Even with this disadvantage, her descriptions, as recorded by Gilbert Wilson, are by far the best and most detailed available in the literature.

As related by Buffalobird-woman, scapula hoes were hafted onto a handle with raw hide thongs, so that the bone was held at right angles to the handle (Wilson 1917:12, 105). The hoes were used to prepare the gardens, and to cultivate around the seed hills while the plants were growing. Gardening was conducted in the flood plain of the Missouri, below the first terrace where the villages were located. Fields were clearly marked out and cultivated by the women from individual families, using wooden digging sticks and antler rakes, as well as scapula hoes (Wilson 1917:12, 105). Using this type of technology, only flood plain gardening was possible. Cultivation of the prairie uplands, with their dense, tough sod, had to await Euro-American settlement and John Deere's invention of the mold board plow in the 19th century. Their long adaptation to flood plain agriculture left the three river tribes at Fort Berthold poorly prepared to deal with upland agriculture after the construction of Garrison Dam in the 1950's (Meyer 1977:211-234).

Manufacture of scapula hoes generally consisted of chopping off the vertebral spine and posterior ridges, and sometimes grinding the areas until they were smooth (Fig. 14). On some specimens, marks from the hafting thongs as described by Buffalobird-woman are still visible. The glenoid fossa is not modified, but most of the KNRI specimens show a shallow notch worn in the edge, presumably where the bone rubbed against the hafting element. This feature has been observed on scapula hoes from Nebraska Phase sites (Blakeslee and Caldwell 1979:67). Scapula hoes must have had considerable value, as many were reused after breakage until they were quite small. Metal and stone cut marks from manufacture are sometimes visible,

Figure 14. Scapula hoe and hide processor from the Knife River villages. a: scapula hoe; b: scapula hide processor.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but on heavily used tools, these traces of manufacture have been largely erased by abrasion from the soil and from the hafting elements. The working blade edge presents very distinctive wear, consisting of polish, and distinct deep striations parallel to the long axis of the tool. This pattern is clearly visible even on small fragments.

Scapula Hide Processors

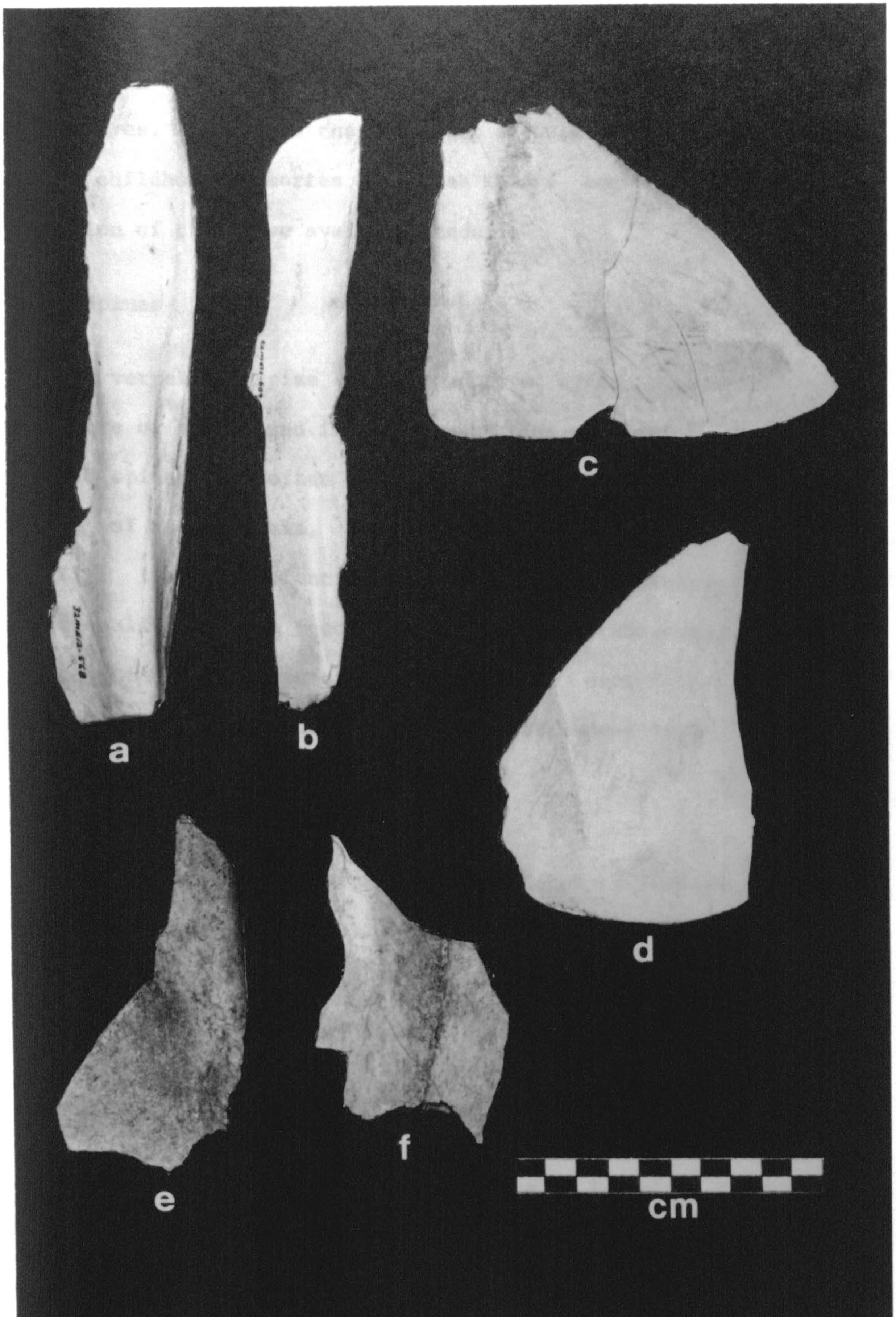
These tools are also referred to as scapula skin processing tools, and hide wringers. They consist of bison scapulae with the central, thin portion of the blade broken out, leaving a V-shaped cavity. The edges of this cavity are worn and polished, as if by abrasion against pliable material (Fig. 14). Most of the tools from the KNRI collections have the vertebral spine and posterior border chopped away, as would be expected if the tool were to be a scapula hoe. However, some specimens retain the vertebral spine Another variation of this tool type is to utilize a hole through the blade, rather than breaking out the central portion of the blade.

These artifacts were identified by Bell (1971) as hide processing tools on the basis of materials from the Washita River Focus in Oklahoma. He believed that the tools were used in the hide tanning process, where the hide was pulled back and forth through the tool in order to make it soft and pliable. In a summary article, Hofman (1980) found the tools to be widespread on the Plains, but generally small in number. Ethnographic information from the Menominee suggests that scapulae of deer and other large animals were used in the processing of bark fibers to make cordage. The boiled fibers were pulled through a scapula with a hole in the blade, in order to make them soft and pliable. Ethnographic accounts of the Cheyenne describe how they used bison scapulae during the hide tanning process. The scapula was tied to a tree, and the hide was passed back and forth through a hole in the blade until it had softened (Hofman 1980:137). These tools exhibit considerable variation in morphology, and were apparently curated until non-functional (Hofman 1980:138). Differentiation between fiber and hide processing is not possible in the KNRI villages, given the perishable nature of both fiber and hides. However, given the quantity of bison bone in the deposits, a function as hide processors seems more likely.

Scapula Knives

These tools are also quite common in Middle Missouri Plains Village sites. They are made from the thin section of the bison scapula blade, and are carefully shaped and ground to be held in the hand. Their manufacture creates a distinctive pattern of deep striations parallel to the working edge (Fig. 15). Scapula knives are often referred to as "squash knives", from descriptions provided by Buffalobird-woman (Wilson 1917:106). Although she had never seen one being made, she related that the tools were cut from green bone, which would hold an edge for a long time without sharpening. They had no handle other than the bone, and to her recollection, they

Figure 15. Scapula tools from the Knife River villages.
a-b: scapula spines; c-d: scapula knives;
e-f: scapula fragments.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were used only for slicing squashes. These tools passed from use at Like-A-Fishhook village when she was young and were replaced by steel knives. As was the case with scapula hoes, Buffalobird-woman's childhood memories of squash knives constitute the best description of their use available today.

Scapula Spines

The vertebral spine is removed from bison scapulae during manufacture of hoes, and in some cases, hide processing tools. The detatched spines were often discarded. However, some of them show evidence of use as tools, as indicated by localized polish on one end (Fig. 15). The function of these tools is unknown, and they have generally not been recognized in bone tool assemblages. They approach the definition of expedient tools, except that they are made from manufacturing debris instead of fractured bones.

Scapula Fragments

These items consist of fragmentary pieces of scapulae, almost all from the blade (Fig. 15). They cannot be positively identified as to tool function, but it is likely that the vast majority came from digging tools or hoes, with a smaller number from knives and hide processing tools. Their presence is considerable, totaling 204 specimens. This category was not generally retained in earlier excavations, and in this case, its presence is largely a function of water screen recovery and careful sorting. Although these fragments are not especially spectacular, they serve a function in analysis by indicating the presence of scapula tools.

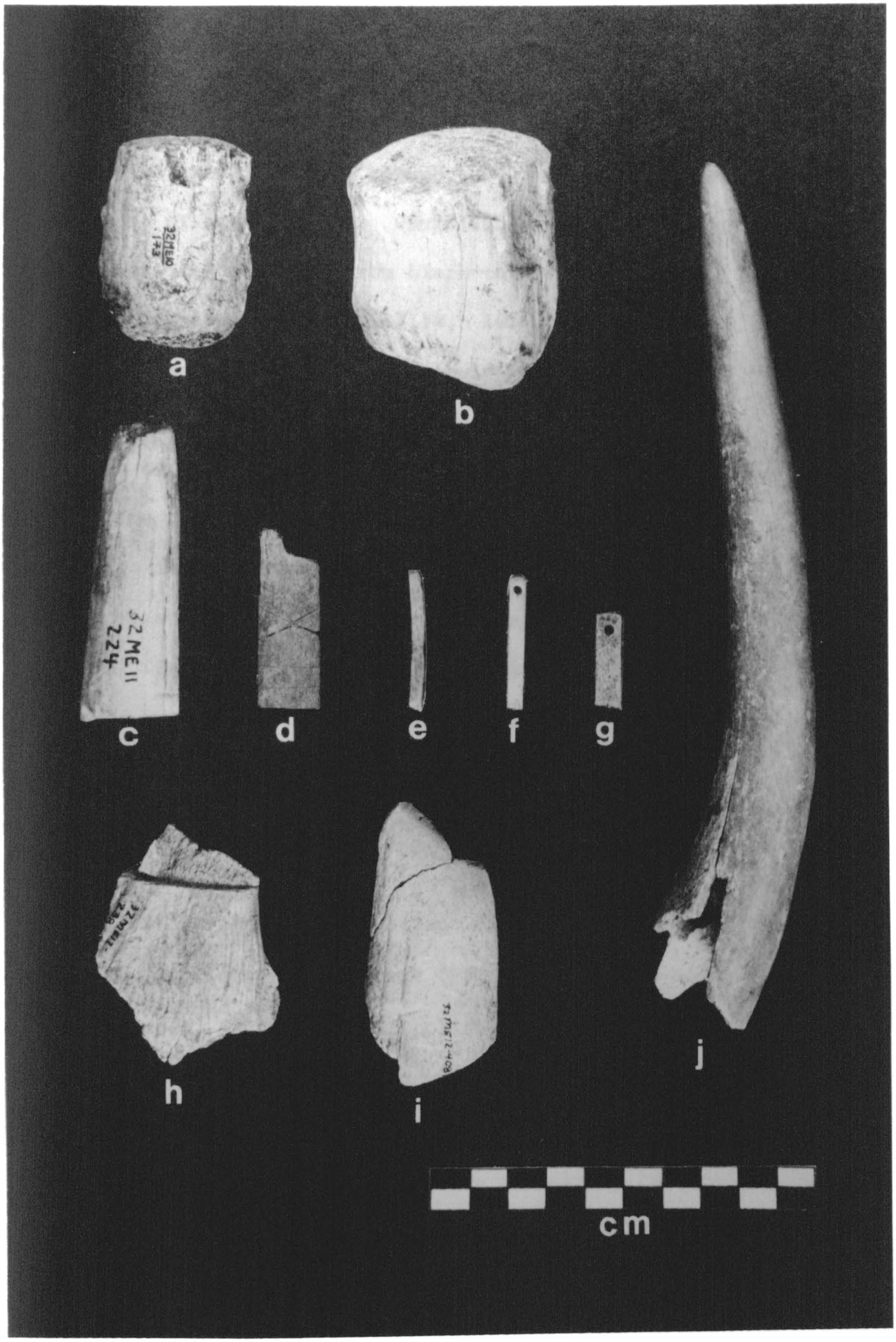
Antler Tools

Antler is a different material from that making up the bone tools discussed so far. It is obviously from deer and elk, as bison horns are readily distinguishable from antler. One very important factor is that antler is the only portion of an animal's skeleton which is outside the body during life. As such it is subject to all manner of abrasion, such as being dragged through bushes or being struck against the antlers of another animal during mating season. The wear and striations observed on antlers from the KNRI collections may therefore have been at least partially caused by activities prior to the death of the animal. Some tool identifications, especially where clear cut marks are not present, may therefore be suspect.

Antler Tines

These tools consist of pieces of antler with the natural tips present. Some show evidence of wear and striations as well as pitting on the tips (Fig. 16). These tools are common in Middle Missouri Plains Village sites, and have generally been interpreted as pressure flakers, used in the manufacture of chipped stone tools (Smith 1977:106; Wood 1967:95-96). At the Huff site, the nicks and striations on the tips of these artifacts resembled those found on antler tines used in experimental flaking of chert (Wood 1967:96).

Figure 16. Antler tools from the Knife River villages. a–b: antler beams; c: antler ice glider; d–e: antler strips; f–g: antler needles; h–i: antler debris; j: antler tine.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This suggestion of function is certainly reasonable, since antler tines are widely used as pressure flakers by contemporary flint knappers.

The other possibility, though, is that these tines represent broken tips of antler rakes. Bufflaobird-woman described these tools as having been made from black-tailed deer horn for use in garden cultivation (Wilson 1917:14, 105-106). The pitting and striations observed on the tips could well have been formed by abrasion against the soil in the gardens. In the absence of systematic experimental analogs, it is impossible to distinguish between the proposed functions with certainty. The final possibility is that the observed wear was produced when the antler was part of a deer or elk and was being abraded against all manner of objects in the environment. Observation indicates that most tines can be assigned to human modification with confidence, although their precise function remains unknown.

Antler Beams

These items consist of sections of antler without the tips or substantial portions of the base (Fig. 16). They show apparent evidence of use, in the form of polish, striations, pitting, and battering. They may have functioned as sections of hammers, pressure flakers, or rakes. Rakes and pressure flakers have been discussed above. Antler hammers are relatively common in post-contact Middle Missouri villages (Lehmer 1971:158-159). The roughly circular base of the beam was used as a mallet with an attatched segment of antler serving as a handle. Such tools would have performed a variety of functions, including soft-hammer percussion flaking of stone tools.

Antler Strips

These artifacts consist of very thin, carefully worked strips of antler (Fig. 16). It is clear that they functioned as jewelry, since complete bracelets made of these strips have been found elsewhere in the Middle Missouri (Smith 1977:109). Antler strips and bracelets show the laborious nature of ornament and jewelry manufacture prior to Euro-American contact. The disappearance of these items as substitutes were introduced through the fur trade will be examined in the following chapter.

Antler Needles

Antler needles are similar to the strips described above. They are very thin and well made, and have an eyelet bored through one end (Fig. 16). It is believed that they functioned as needles for sewing leather clothing together with sinew. They were probably not used for boring holes through the leather. That task was performed with somewhat stronger awls, described below.

Antler Debris

This category consists primarily of manufacturing debris left over after making antler tools such as those described above. Many of the specimens in this category exhibit clear cut marks, unobscured by subsequent use (Fig. 16). This is therefore a valuable category, since manufacturing marks are very well preserved. Some of the debris may have been modified while still part of an animal, but most shows distinct evidence of modification.

Antler Ice Gliders

Ice Gliders, also referred to as snow snakes, are relatively rare in most Plains Village sites. Their function is known from historic accounts, which describe them as being part of a simple competetive game played in the winter. The single specimen in the KNRI collections was found on the beach below the Sakakawea site and consists of a shaped cone of antler with the base hollowed out (Fig. 16). The hole in the base was designed so as to receive a long wooden shaft. The completed artifact resembled a javelin. It was thrown so as to slide along the crusted snow, in a game where the winner was determined by the longest throw (Fenenga 1954; Lehmer 1971:157).

Piercing Tools (Awls)

Piercing tools or awls are very common in pre-contact Plains Village sites. For example, awls form one of the most numerous tool types at the Huff site (Wood 1967:89-91), the Demery site (Woolworth and Wood 1964:120-122), the Paul Brave site (Wood and Woolworth 1964:42-43), and the Jake White Bull site (Ahler 1977:109). In the KNRI collections, there are only 33 awls from all three villages combined. The implications of this low frequency in light of the Fur Trade will be discussed in the next chapter.

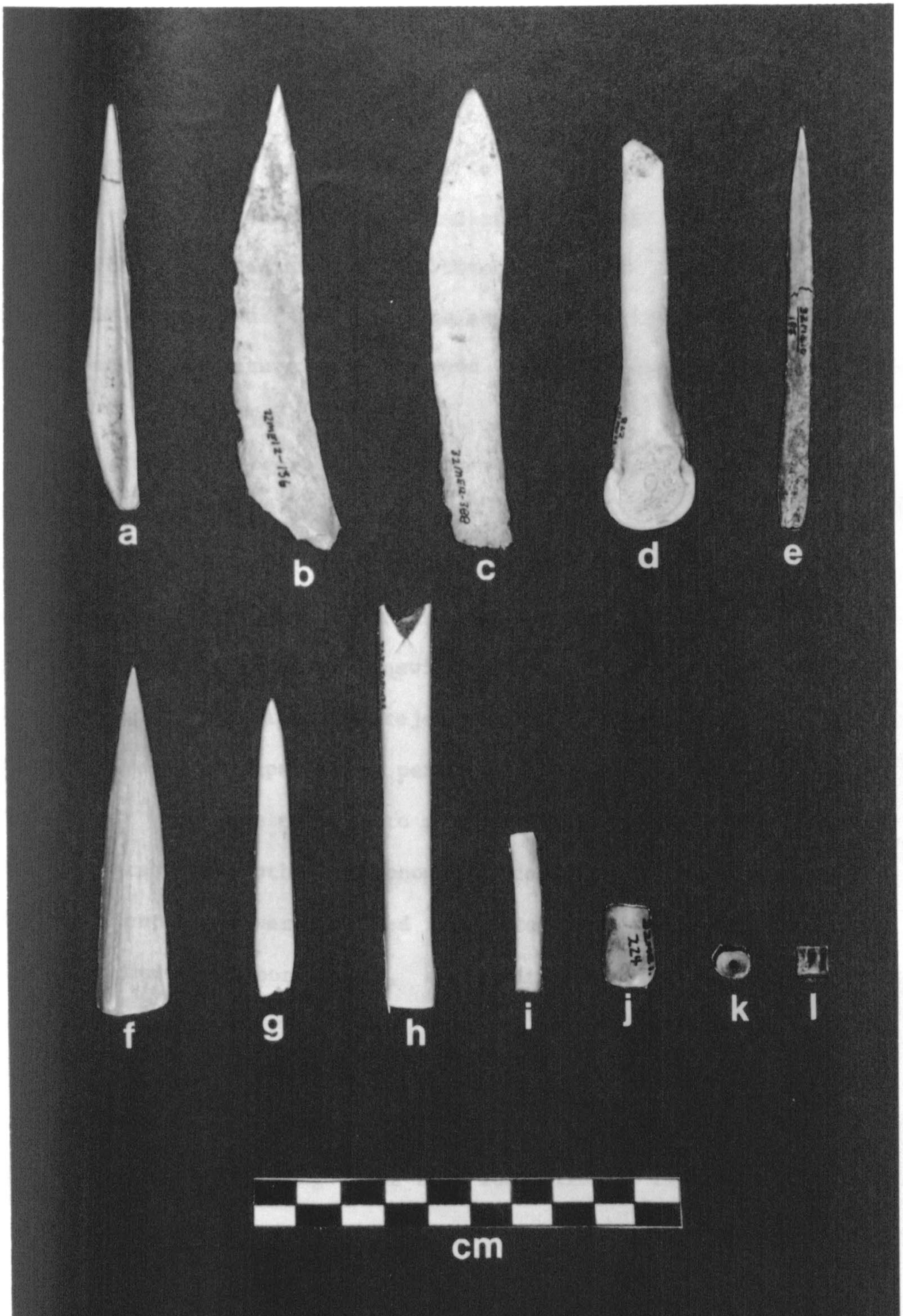
Awls from the KNRI collection are small piercing tools with slender tips, quite similar to awls from other nearby sites. They have been divided into several categories based upon biological element. These are indeterminate element, metapodial awls, rib awls, splinter awls, and scapula awls (Fig. 17). In each case, classification as an awl was based upon the presence of a slender piercing tip, regardless of biological element.

Tubes/Beads

Tubes/beads apparently functioned as jewelry or ornaments. They were laboriously manufactured from small animal long bones, probably canid (Fig. 17). Further taxonomic identification is impossible, since the tubes have been ground and highly polished, removing all traces of identifiable facets. Only one has been classified as a bead, based upon its very small size. All others fall into the categories of split and non-split tubes, although they probably all functioned as ornaments.

Perforated fish vertebrae are a special case within this category. They are made from the vertebrae of large fish, with all the spines removed. A hole is bored through the center of the vertebrae, allowing it to function in the same manner as the bone beads discussed above (Fig. 17). This is an example of the type of artifact which can be recovered using a water screen system in the

Figure 17. Awls and tubes/beads from the Knife River villages. a: splinter awl; b-c: rib awls; d: metapodial awl; e-g: splinter awls; h-j: tubes/beads; k-l: perforated fish vertebrae.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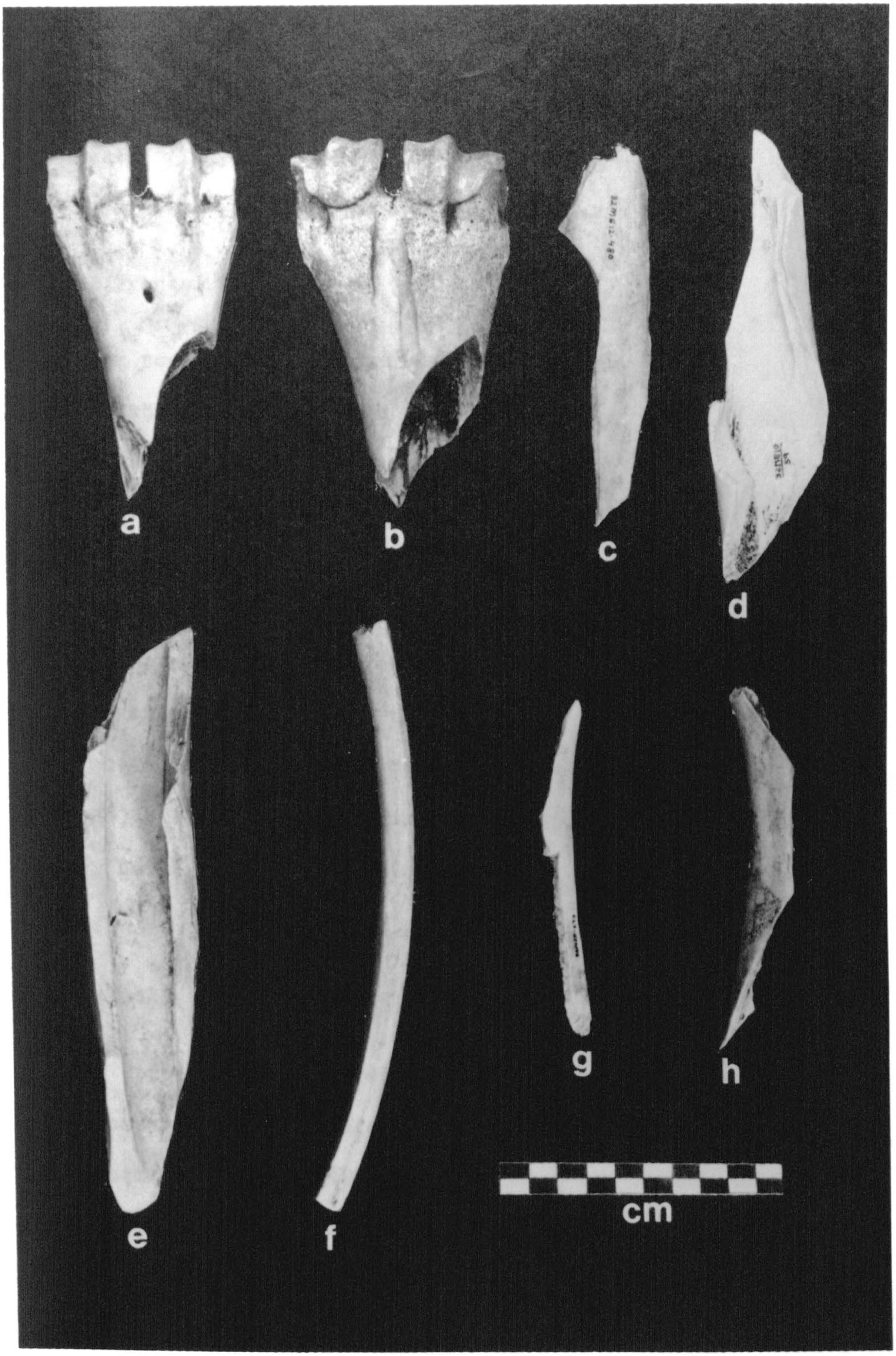
field and careful sorting in the laboratory.

Expedient Tools

Expedient tools were discussed in some detail in the previous section. They have been defined at sites on the Plains, are altered only by fracture, and are used in butchering. In separating these tools from unmodified fauna for this analysis, criteria established in the recent literature were employed (Frison 1970, 1978; Johnson 1982).

These tools are very susceptible to alteration from taphonomic processes such as trampling and scavenging by carnivores. Therefore, in order for tools to be assigned to this category, they had to have more than a fortuitous break and a little polish. Specimens showing carnivore gnawing on one end and a little polish on the other were likewise rejected. The separation was made conservatively by experienced personnel, and the expedient tools identified here are thought to represent human alteration rather than alteration by other taphonomic processes. For this analysis, the expedient tools were divided into categories based upon element. These include long bone shaft, shaft with articular end present, ribs, and scapulae (Fig. 18). Ribs and scapulae are included here since they fit the criteria of being modified only by fracture and subsequent use. This is somewhat of a departure from past analyses where only fractured long bones were identified as expedient tools.

Figure 18. Expedient tools from the Knife River villages. a-b: articular end present; c-e: long bone, shaft only; f-h: ribs.


a
b
c
d
e
f
g
h
cm

Other Tool Categories

The following tool categories have been treated individually in the analysis. They cannot be grouped as to major biological element in the same manner as those described above.

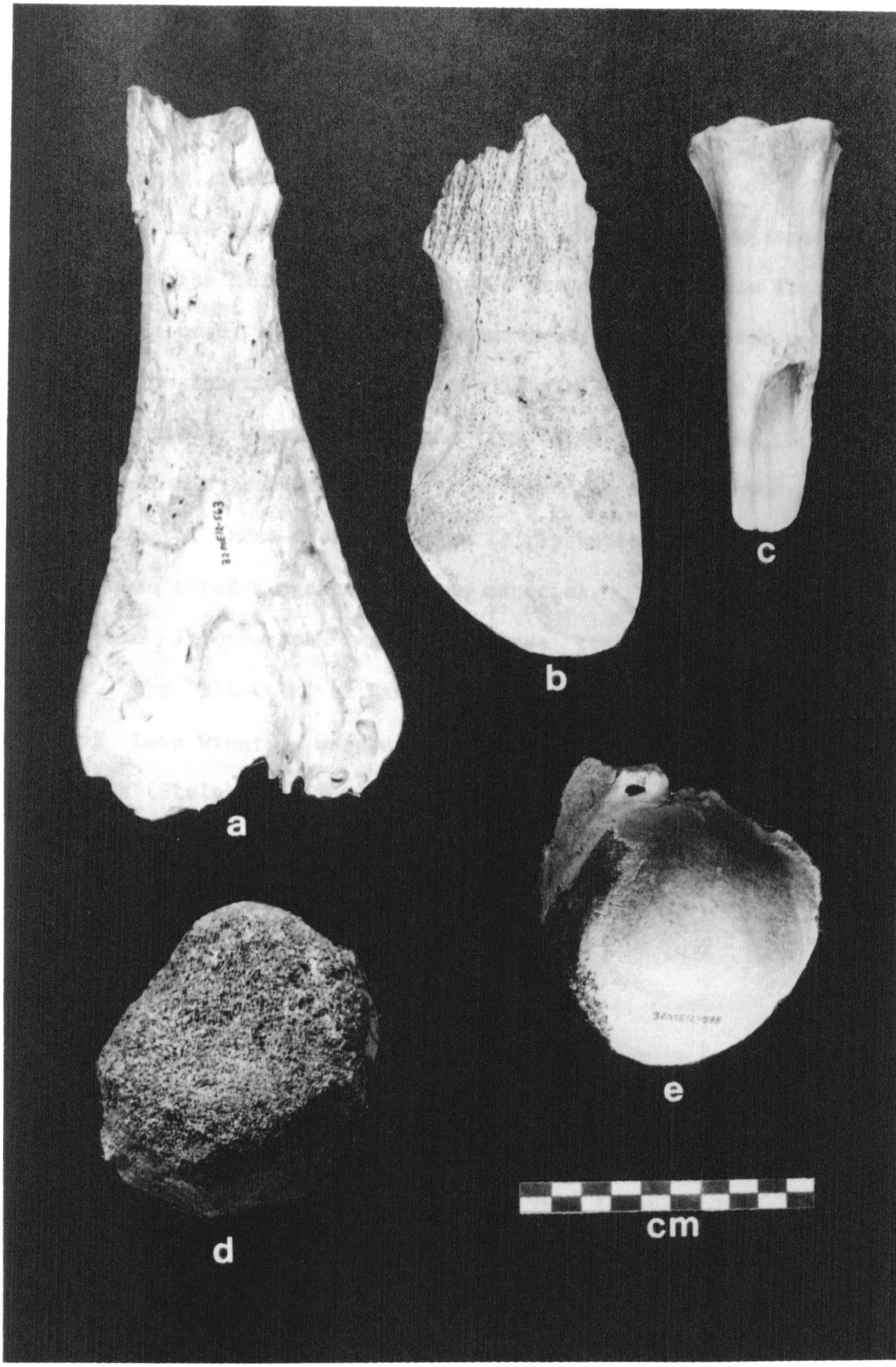
Horn Core/Frontal Tools

These tools are manufactured from the bison horn core and adjacent portion of the frontal bone. There are two such specimens in the KNRI collections which have been modified so that a portion of the frontal bone serves as a working edge (Fig. 19). The wear along the edge is identical to the deep striations and polish, parallel to the tools' long axis, that has been observed on scapula hoes. The horn core/frontal tools in the collections were evidently used as digging tools. Similar tools at other Middle Missouri Plains Village sites have received a similar classification (Lehmer 1971:84-85). The tools are small when compared with scapula hoes, and may have been hand-held as they also show no evidence of hafting.

Fleshing Tools

Hide processing tools referred to as "fleshers" are common in Middle Missouri Plains Village sites. Most specimens are made from bison metatarsals (Lehmer 1971:86-87). They are formal tools, made by cutting off the distal end of the bone, so that a beveled chisel edge is left. Sometimes, the tarsal bones and calcaneous are left

Figure 19. Horn core/frontal, fleshing, and cancellous tools from the Knife River villages. a-b: horn core/frontal tools; c: flesher; d-e: cancellous tools.


a
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attatched to the proximal end of the metatarsal, where they presumably served as a handle, held in place by hide and ligaments (Fig. 19). In the KNRI, one specimen is made from a split section of bison radius, instead of the usual metatarsal.

Fleshers are used to remove the flesh adhering to the inside of a hide, when the hide is stretched on a frame. Bone tools function well for this task, since they will remove the flesh without cutting the hide. The function of these tools is assigned here on the basis of morphological similarity to tools from other sites, and the lack of characteristic grooves such as those found on scapula hoes. The working edge of these tools exhibits fairly uniform polish, as if they had been abraded against pliable material. There is also some ethnographic information regarding these tools. Until fairly recently, the Black River Band of Ojibwa along the southeastern shore of Lake Winnipeg were using bone fleshers made from moose metapodials (Steinbring 1966).

Cancellous Tools

These tools are manufactured by cutting through the large joints at the ends of bison long bones. The abrasive working surface is created by exposing the cancellous bone in the interior of the joint (Fig. 19). Cancellous tools are believed to have been used in hide processing, and are referred to as "hide grainers" (Lehmer 1971:158-159; Smith 1977:109). This is probably a logical suggestion, since most of the cancellous tools from the KNRI collection exhibit smooth, worn facets. They have also been referred to as paint brushes, as some have been found with pigment adhering to the cancellous surfaces (Lehmer 1971:158-159). None was found with pigment in the KNRI collections.

The suggested functions of cancellous tools seem quite logical and may well be accurate. However, like perforated ribs, cancellous tools have entered a "folk taxonomy" where ethnographic information is not readily available.

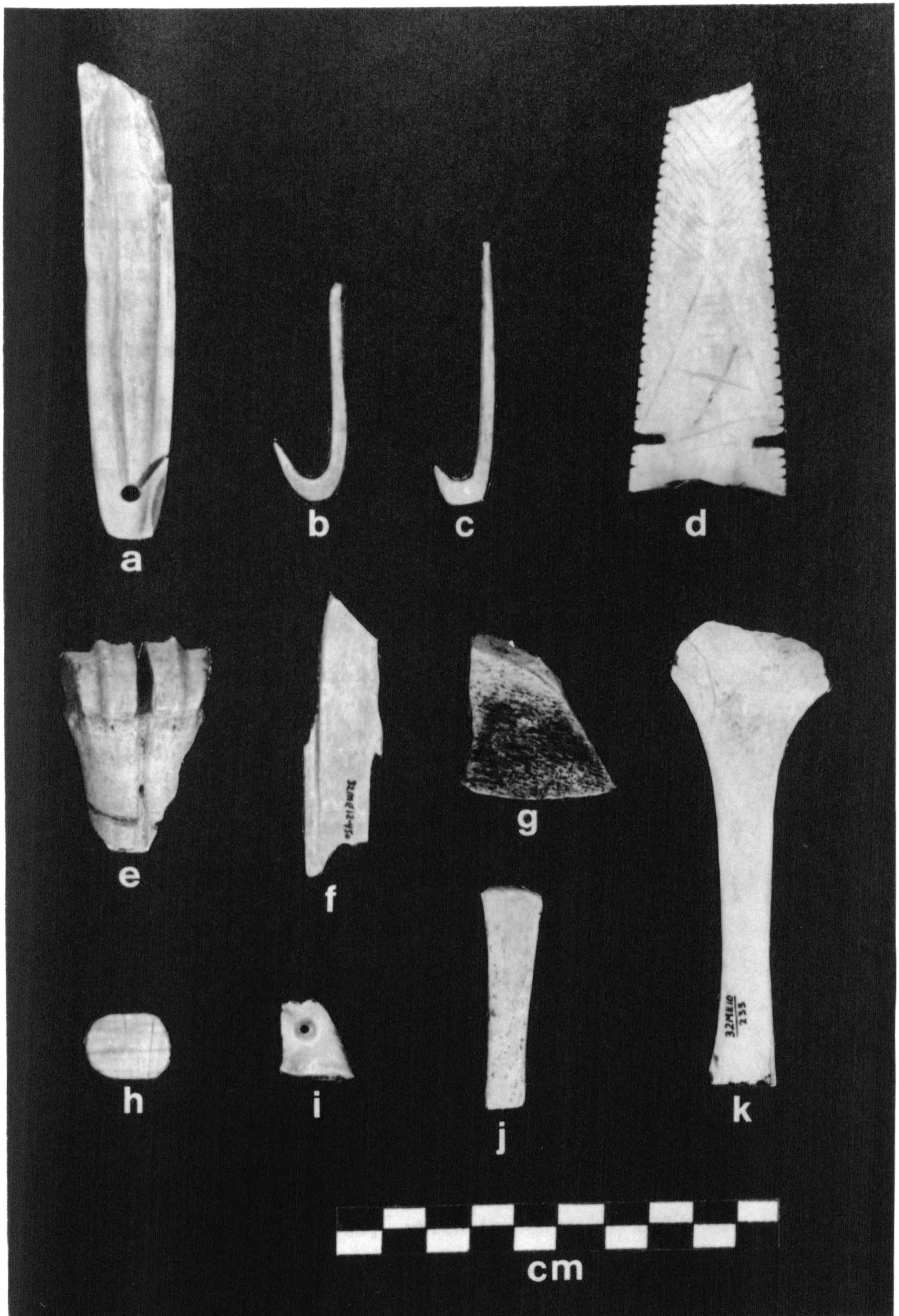
Fish Hooks

Fish hooks were cut in a laborious manner, from compact bone by scoring the tool´s outline (Fig. 20). The finished products are well made, and have small notches cut into the shank, instead of an eyelet as would be found on metal fish hooks (Fig. 20). Bone fish hooks were common items in Middle Missouri Plains Village sites prior to Euro-American contact. However, small laboriously made products such as this could have easily been replaced with machine-made metal fish hooks, which were available in quantity by early in the 19th century (Lehmer 1971:92, 156). Even before machine-made fish hooks were available, small scraps of metal could have been pounded and bent into a serviceable and durable shape.

Manufacturing Debris

This tool category consists of a variety of bones left over after the manufacture of formal tools (Fig. 20). As is the case with antler debris, this category is valuable in that the types of

Figure 20. Miscellaneous tool categories from the Knife River villages. a: partially completed fish hook; b-c: complete fish hooks; d: ornamental projectile point; e-f: manufacturing debris; g: ochre-stained bone; h: gaming piece; i: pendant; j-k: unique objects.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manufacture processes, and especially the types of tools used in manufacture, can be readily determined. This is because manufacturing debris is discarded during the process of making tools and is not further altered by use. This is another tool category which might not be retained or examined in the absence of water screening and careful sorting of faunal materials.

Polished Fragments

This category consists of small fragments of utilized bone which are not identifiable as to element. This is a valuable category, in that it can be used to delineate concentrations of modified bone, and to provide quantification. This is definitely a category which would not be included in analysis without use of a water screen system and careful laboratory sorting.

Ochre-Stained Bone

There are 3 specimens in the KNRI collections with pigment imbedded in the bone (Fig. 20). The obvious suggestion is that they were used in the application of pigment, much like the cancellous "paint brushes" described by Lehmer (9171:158-159).

Ornaments

The ornaments in the KNRI collections are laboriously prepared objects with little utilitarian value. These include the beautiful bone point from Big Hidatsa, which is believed to be an ornament (Fig. 20). This assessment is made on the basis of the artifact's delicacy, despite Lehmer's (1971:66-67) belief that some of these points may have been utilitarian. This category also includes carefully made bone disks, which have been classified as gaming pieces (Fig. 20). The KNRI specimens are very similar to disks found at the Huff site (Wood 1967:91-92). Ornaments such as these were difficult and time consuming to make. They would have been quickly replaced by Euro-American trade ornaments, and this replacement will be explored in the next chapter.

Unique Objects

This is an inevitable category in any analysis. Included here are a variety of small utilized mammal bones of unknown functions (Fig. 20).

ANALYSIS RESULTS

This chapter will present a tabulation and discussion of analysis results from the Lower Hidatsa, Sakakawea, and Big Hidatsa modified bone assemblages. Each assemblage will be examined in detail, and changes through time will be illustrated and discussed. This will be done using the bone tool variables discussed in the preceding chapter: tool type, metal/stone modification, predominant method of manufacture, and use phase class. Assemblage change through time will be discussed using the provenience variables presented in the preceding chapter and temporal components developed for each site.

The assemblage changes to be examined in this tabulation of results have been discussed in previous chapters. They occur as a result of Euro-American contact, brought to the area by means of the fur trade. Changes expected in the assemblages include the disappearance of bone tool types as metal substitutes became available, changes in the frequencies of metal and stone modification of bone, and changes in predominant manufacture strategy.

The organization of this chapter will proceed as follows. First, the structure of the assemblage from each village will be examined. This will include examination of tool type distributions, provenience, and degree of fragmentation and recycling. This will be followed by a discussion of assemblage change through time at each site, using components developed in the original technical reports and in subsequent research. Then, all mixed components and other extraneous materials will be deleted in order to provide a clearer picture of assemblage change at each of the three sites. Finally, the entire assemblage will be collapsed into one sequence in order to observe broad changes during the entire Hidatsa occupation in the Knife River villages. The concluding section will examine the changes within the context of the fur trade.

Assemblage Structure

Subsequent discussions in this chapter will focus primarily upon bone tool assemblages as they change through time. Before discussing temporal change, it is necessary to examine the structure of each site assemblage. Assemblage variability as related to provenience variables such as house area and feature type will be examined. Patterns in tool-specific variables such as metal/stone modification, use phase, and predominant method of manufacture will also be discussed. The data will be presented primarily in tabular form, generated using the SPSS-X computer-assisted statistical program.

Distribution by Site Area

The first examination of assemblage structure concerns site area. Tool types have been cross-tabulated by site area for each village, in an effort to illustrate areal concentrations in the assemblages. Site areas and excavation unit placement have been discussed in detail in an earlier chapter, so they will be given only brief treatment in this section.

Lower Hidatsa

At the Lower Hidatsa site (32ME10) 293 modified bone specimens were recovered, and Table 13 presents a cross-tabulation of tool types by site area. Examination of Table 13 shows an obvious concentration of materials in the 1978 UND/NPS excavations (82.2%). There are four 1978 north units, one inside house 3 and three outside the houses, oriented north-south so as to cross the abrupt northern margin of the site midden. Between them, these four units contain 66.2% of the collection. The 1978 south unit is located near the southern margin of the site in an outside house context, and contains 16.0% of the collection. The data in Table 13 indicate that a full range of modified bone tool types are represented in the five UND/NPS excavation units, primarily because of the water screen recovery system employed in the field.

Lehmer's two excavation units were located in the southern portion of the site near the 1978 south unit, at now unknown locations. They were excavated in outside-house contexts, near the 1978 south unit. Bone tools from these units represent 15.4% of the total collections, but this percentage is somewhat deceptive given the differences in recovery procedures employed by Lehmer and by the UND/NPS field crew in 1978. Lehmer did not screen the fill from his excavations, and this can be seen in the distribution of tool types from his test units. Most are complete, formal tools, with little

Table 13. Cross-tabulation of tool types by site area, Lower Hidatsa village (32ME10), 1978 excavations and 1965 Lehmer excavations.

Tool Type	Site Area: Surface	1978 South Unit	1978 North Unit	Lehmer Tests	Total/ Percent
Split Ribs	2	9	22	5	38 13.0
Slotted Ribs, Unknown Blade			1		1 .3
Slotted Ribs, Metal Blade			5	5	10 3.4
Slotted Ribs, Stone Blade			1	1	2 .7
Perforated Ribs	2	1	4	3	10 3.4
Dorsal Spines			1		1 .3
Scapula Hoes		1	13	3	17 5.8
Scapula Knives			1	2	3 1.0
Scapula Hide Wringers			3		3 1.0
Scapula Spines		2	9		11 3.8
Scapula Fragments		7	24	10	41 14.0
Antler Tines	1		7	1	9 3.1
Antler Beams			4		4 1.4
Antler Strips			2		2 .7

Table 13, cont'd.

Tool Type	Site Area: Surface	1978 South Unit	1978 North Unit	Lehmer Tests	Total/ Percent
Antler Needles			2		2 .7
Antler Debris		2	11	1	14 4.8
Awls		1	5		6 2.0
Metapodial Awls		1	1	1	3 1.0
Rib Awls		1			1 .3
Splinter Awls		3	5	1	9 3.1
Fleshers			4	2	6 2.0
Cancellous Tools			4		4 1.4
Fish Hooks			2		2 .7
Tubes/Beads		1			1 .3
Complete Tubes	1	4	6	4	15 5.1
Split Tubes		1	9		10 3.4
Perforated Fish Vertebrae				2	2 .7
Expedient Tools/ Shaft		1	12		13 4.4
Expedient Tools/ Articular			2		2 .7

Table 13, cont'd.

	Site Area				
	Surface	1978 South Unit	1978 North Unit	Lehmer Tests	Total Percent
Expedient Tools/ Rib		2	6	1	9 3.1
Manuf. Debris		4	4	3	11 3.8
Polished Fragments		1	20	1	22 7.5
Ochre Stained Bone		1	1		2 .7
Ornaments	1	1		1	3 1.0
Unique Objects		3	1		4 1.4
Total Percent	7 2.4	47 16.0	194 66.2	45 15.4	293 100.0

representation of fragmentary items. Lehmer's collections have been helpful, but as will be seen below, it has been difficult to integrate them fully into the analysis.

Sakakawea

The Sakakawea village is located in a much different setting than the other two major sites. It is located at the edge of the Knife River, and was actively eroding into the river at the time of field work. The cross-tabulation of tool types for 211 artifacts by site area at Sakakawea village is presented in Table 14. The percentage of surface artifacts at the site is relatively high (14.7%), because of the erosion of site matrix into the river. Many artifacts were collected from the beach at the base of the cutbank during times of low water. These collections are extensive and include, unfortunately, the only ice glider recovered from the three villages (Table 14).

Lehmer's test 1 was excavated in 1965 at the cutbank margin, and as was the case at Lower Hidatsa, the fill was not screened. The 1976 tests contain 56.4% of the collections. These excavations consisted of the salvage of slump blocks along the cutbank margin in the southeast portion of the site. The fill was water screened in the field, and a full range of modified bone specimens is present. The 1977 mid-bank and north-bank tests are both 1 x 2m excavation units placed near the cutbank margin. The small size of these units is primarily responsible for the small number of artifacts recovered from them. The 1977 interior units are a pair of 1 x 2m excavation

Table 14. Cross-tabulation of tool types by site area, Sakakawea village (32ME11), UND/NPS and Lehmer excavations.

Tool Type	Site Area: Surface/ Beach	Lehmer Test 1	1976 Tests	1977 Midbank	1977 Northbank	1977 Interior	Total/ Percent
Split Ribs			3				3 1.4
Slotted Ribs, Unknown Blade				1			1 .5
Slotted Ribs, Metal Blade			3		1		4 1.9
Perforated Ribs		1	2				3 1.4
Scapula Hoes	7		6	1	1		15 7.1
Scapula Knives	1		5				6 2.8
Scapula Hide Wringers	1						1 .5
Scapula Fragments	10	2	37	9	11	5	74 35.1
Antler Tines	1		5		1	1	8 3.8
Antler Strips			1				1 .5
Antler Debris			2		4		6 2.8
Antler Ice Glider	1						1 .5
Metapodial Awls			1				1 .5
Rib Awls			1				1 .5
Scapula Awls			1				1 .5
Fleshers	1		1				2 .9
Cancellous Tools			3				3 1.4

Table 14, cont'd.

	Site Area						
	Surface/ Beach	Lehmer Test 1	1976 Tests	1977 Midbank	1977 Northbank	1977 Interior	Total/ Percent
Complete Tubes	4		3	2	1		10 4.7
Split Tubes			7		1	1	9 4.3
Expedient Tools/ Shaft			3			1	4 1.9
Expedient Tools/ Articular	1		5				6 2.8
Expedient Tools/Rib	1	1	5	1	1	2	11 5.2
Expedient Tools/Scapula			1				1 .5
Manuf. Debris	1		3	2	1		7 3.3
Polished Fragments	2		15	2	1	4	24 11.4
Ochre Stained			1				1 .5
Ornaments			2	1	1		4 1.9
Unique Objects			3				3 1.4
Total Percent	31 14.7	4 1.9	119 56.4	19 9.0	24 11.4	14 6.6	211 100.0

units located in the central portion of the site, inside and outside of house 16. The main points to be gathered from the areal distributions at Sakakawea are the high proportion of surface and beach artifacts, and the fact that over half of the collection comes from slump blocks salvaged along the southeast margin of the site (Table 14).

Big Hidatsa

The cross-tabulation of tool types by site area for 390 bone tools from the Big Hidatsa site is presented in Table 15. Donald Lehmer did not conduct excavations at Big Hidatsa, so all of the collection was gathered during the 1980 UND excavations. One of the most obvious facts about the areal distribution is the presence of only two surface artifacts. The site has not been subjected to major looting or cutbank erosion as have the Lower Hidatsa and Sakakawea sites.

There are some clearly visible concentrations in the excavated collections. A clear majority (59.3%) comes from the core area, 28.5% in the northern core and 30.8% in the southern core. The proportion from the northern and eastern peripheries is also signficant, 15.6% and 16.7% respectively. The western periphery, however, produced fewer artifacts, only 5.1% of the collection. The eastern and western margins produced very few artifacts, and the same was true for Mound C, which produced only 2.1% of the total collection.

Table 15. Cross-tabulation of tool types by site area, Big Hidatsa village (32ME12), 1980 excavations.

Tool Type	Site Area: Surface	Core North	Core South	North Periph.	East Periph.	West Periph.	East Margin	West Margin	Mound C	Total/ Percent
Split Ribs		4	4	5	3	3			1	20 5.1
Split Dorsal Spines			1							1 .3
Slotted Ribs/ Unknown Blade			2							2 .5
Slotted Ribs/ Metal Blade		2	1	1	1	1				6 1.5
Perforated Ribs		1	1							2 .5
Dorsal Spines		1		1						2 .5
Scapula Hoes		5	22	2	1	1		1	1	33 8.5
Scapula Knives		2	3	2	1	2				10 2.6
Scapula Hide Wringers		2	2							4 1.0
Scapula Spines		1	1		1					3 .8
Scapula Fragments		26	23	16	16	5			3	89 22.8
Horn Core/Frontal Tools				1	1					2 .5
Antler Beams		1								1 .3
Antler Strips		5			2					7 1.8
Antler Needles	1	1								2 .5
Antler Debris		4	9		1	1	1			16 4.1
Awls		1		2				1		4 1.0

Table 15, cont'd.

Tool Type	Surface	Core North	Core South	North Periph.	East Periph.	West Periph.	East Margin	West Margin	Mound C	Total/ Percent
	Site Area									
Metapodial Awls				1						1 .3
Rib Awls				2		1				3 .8
Splinter Awls		1	1		1					3 .8
Fleshers	1		2		2					5 1.3
Cancellous Tools			2		2					4 1.0
Fish Hooks		2	1	2						5 1.3
Complete Tubes		7	2	2	3	3				17 4.4
Split Tubes		3	1	5						9 2.3
Perforated Fish Vertebrae		1								1 .3
Whistles		1								1 .3
Expedient Tools/Shaft		5	3	2	2				1	13 3.3
Expedient Tools/ Articular			1							1 .3
Expedient Tools/Rib		5	14	2	6					27 6.9
Manuf. Debris		12	7	4	1	1				25 6.4
Polished Fragments		12	14	7	19	1			2	55 14.1
Ornaments		1								1 .3
Unique Objects		2		4	1	1				8 2.1
Total Percent	2 .5	111 28.5	120 30.8	61 15.6	65 16.7	20 5.1	1 .3	2 .5	8 2.1	390 100.0

The modified bone assemblage parallels the general trend for other major material classes, that of the majority coming from the core area, which exhibits the deepest midden deposits and the longest period of occupation. The density of cultural materials is also very high. The surrounding areas, especially the eastern and western margins, exhibit generally thin deposits, with low artifact densities. Few other trends can be seen at this level, other than a concentration of scapula hoes (67%) in the southern core area.

Other Measures of Assemblage Distribution

The tabulations just presented for the three villages are useful for illustrating basic provenience patterns for each bone tool assemblage. However, interpretation beyond those patterns is impossible. It is therefore necessary to employ other tool-specific and provenience variables in order to elicit further patterning. The following section will examine variation in assemblage structure as related to feature type, inside-outside house context, use phase, containment, and house area. The following tables will illustrate assemblage structure for the entire collection, instead of separately for each site. The trends to be described are similar at each site, so separate tabulation for each site assemblage would be redundant.

Site by Feature Type

The distribution of the modified bone assemblage with reference to cultural features and arbitrary excavation levels is important for further discussion, since it does have some bearing on the final conclusions. A cross-tabulation of all three site assemblages by feature type is presented in Table 16. Feature type was recorded for all bone artifacts, and in most cases, general level refers to 15cm arbitrary levels within 1 x 2m excavation units. Examination of Table 16 shows that the majority of tools from all three sites was found in general levels. From the perspective of obtaining a balanced picture of site variability, this is certainly not ideal, but relatively few features containing substantial cultural fill were found during excavation. Also, as will be seen in subsequent tabulations, most general levels were excavated in units in midden areas, where artifact densities are very high.

The next largest category is undercut pits (Table 16). These are the familiar undercut pits of the Middle Missouri Subarea, which were originally excavated to provide secure storage for garden produce. After the produce had been removed, they gradually filled with trash. All of the undercut pits in the Knife River excavations were filled with trash; none were found with their original contents. An identical total of 25.1% of the collections from both Big Hidatsa and Sakakawea were found in undercut pits. That fairly high percentage at Sakakawea is indicative of the large number of pit features salvaged along the cutbank, and at Big Hidatsa, it is probably indicative of the large number of excavation units placed in the site. At the Lower Hidatsa site, only 10.2% of the collection comes from undercut pits, which is probably related to

Table 16. Cross-tabulation of site by feature type for bone tools from all three villages (Lower Hidatsa, Sakakawea, and Big Hidatsa).

Site	Feature Type							
	General Level	Basin Shaped Pit	Flat Bottom Pit	Post Mold	Undercut Pit	Ash Lens	Other Aboriginal	Total/ Percent
Lower Hidatsa	257	2	2		30		2	293 32.8
Sakakawea	155			2	53	1		211 23.6
Big Hidatsa	264	4	1	12	98	7	4	390 43.6
Total	676	6	3	14	181	8	6	894
Percent	75.6	.7	.3	1.6	20.2	.9	.7	100.0

the smaller number of excavation units.

In the total collection from all sites, 75.6% comes from general levels, and the total reached 95.8% when undercut pits are included. The other categories of aboriginal features did not produce many artifacts. This is not surprising in some cases. For example, post molds are relatively common, but contain only 1.6% of the the collection. This is certainly because they are quite small and contain little cultural fill of any kind.

Site by House Area

Inside-outside house context is important in modified bone analysis, given the widely differing activities associated with each location. An effort was made to sample both inside and outside house locations within the context of Phase I research. Table 17 provides a cross-tabulation of each site collection by house area. A clear majority (72.8%) of the modified bone collection comes from outside the houses, and as was seen in Table 16, most of that was recovered in general levels within the midden areas.

Examination of Table 17 indicates that modified bone frequencies within houses are much lower than that outside. This would be expected, since the bulk of trash disposal occurred outside of the houses, away from interior living areas. The materials from inside the houses make up 17.7% of the total, with the bulk of that concentrated in sub-floor undercut cache pits (15.5%). Trash was deposited in these features while the houses were occupied, but the quantity is very small when compared with that deposited outside in

Table 17. Cross-tabulation of site by house area for bone tools from all three villages (Lower Hidatsa, Sakakawea, and Big Hidatsa).

Site	House Area				Total/ Percent
	Unknown	Outside House	Inside House Roof	Inside Floor&Feat	
Lower Hidatsa	11	245	8	29	293 32.8
Sakakawea	38	148	7	18	211 23.6
Big Hidatsa	35	258	5	92	390 43.6
Total	84	651	20	139	894
Percent	9.4	72.8	2.2	15.5	100.0

the midden piles. Very little of the inside-house collection comes from roof fall zones (2.2%). This would be expected, since house roofing materials would not be likely repositories for discarded artifacts and other cultural materials.

Only a small fraction of the collection is contained within the houses. With so much of the sample in outside midden piles, it is difficult to make meaningful statements regarding inside-outside house differences. For this reason, inside-outside house comparisons will not be a major focus of the final conclusions.

Use Phase

Use phase is a very important variable for use in description of assemblage structure: it can be used as a measure of artifact fragmentation, use, and recycling. The next four tables will examine use phase in the modified bone assemblages by site, and as related to containment, feature type, and house area.

Site by Use Phase

The first aspect of this variable to be examined is that of the use phase distribution of artifacts from each site assemblage (Table 18). There is a very clear pattern, in that over 90% of the assemblage is contained in use phases 3 and 4. Use phase 3 consists of complete, unfractured, usable artifacts while use phase 4 consists of fractured, exhausted, or non-functional artifacts. Here, use phase 3 comprises 18.2% of the assemblage while use phase

Table 18. Cross-tabulation of site by use phase for bone tools from all three villages (Lower Hidatsa, Sakakawea, and Big Hidatsa).

Site	Use Phase						Total/ Percent
	1	2	3	4	5	6	
Lower Hidatsa	1	4	76	185	8	19	293
							32.8
Sakakawea		1	46	144	5	15	211
							23.6
Big Hidatsa	2	2	41	321		24	390
							43.6
Total	3	7	163	650	13	58	894
Percent	.3	.8	18.2	72.7	1.5	6.5	100.0

4 constitutes 72.7% of the assemblage. This pattern of strong bias toward fractured, exhausted artifacts might be expected, given the amount of the assemblage which comes from trash deposits, especially in outside-house midden deposits. The majority of the bone tool sample available for analysis is thus comprised of discarded, non-functional artifacts. Given the time and skill investment involved in the manufacture of formal bone tools, it would be unlikely for substantial numbers of them to be discarded while still usable.

The other use phase classes contain many fewer artifacts, especially 1 and 2. Use phase 1 represents blanks or preforms, while use phase 2 consists of unfinished artifacts, broken during manufacture. The low frequency of these classes (0.3% and 0.8% respectively) may be indicative of successful completion of most bone tool manufacturing processes. Use phase 5, artifacts recycled after breakage, is also quite small (1.5%). A small number of artifacts coded as use phase 4 may in fact have been recycled, with such evidence being erased by heavy use wear. This would suggest that few formal bone tools were recognizably recycled. Evidently, most broken tools were discarded, with no effort made to recycle them. Use phase 6, artifacts modified only by breakage (6.5%), is essentially composed of expedient tools. Further discussion of these artifacts will be undertaken later in this chapter.

Containment by Use Phase

Containment is a variable describing the location of an artifact relative to its immediate surroundings, either an open midden area, or a contained feature, such as a pit or post. Cross-tabulation of containment by use phase for the entire assemblage is presented in Table 19. Containment as related to use phase was examined in the belief that the artifact assemblage might be more fragmented in uncontained, or midden locations. In such locations, the potential for breakage from taphonomic processes such as trampling and carnivore gnawing is higher, and might lead to a more fragmented assemblage with a higher proportion of use phase 4 artifacts. This was not found to be the case (Table 19). The sample from contained contexts is much smaller, but the percentage of use phase 3 is virtually the same between contained and uncontained contexts (18.8% and 18.5% respectively). Use phase 4 is also quite similar between contained and uncontained (76.1% and 70.7% respectively). These precentages illustrate a similar disposal pattern in both contexts. There is less material in contained areas such as undercut pits, but it is all trash with little difference in fragmentation. There were few usable tools being discarded in either context.

Feature Type by Use Phase

The similarity of fragmentation, use, and recycling among provenience contexts can be examined by looking at a cross-tabulation of feature type by use phase (Table 20). This table reflects some of the same trends evident in the preceding tabulations. The majority of the combined assemblage is

Table 19. Cross-tabulation of containment by use phase for bone tools from all three villages (Lower Hidatsa, Sakakawea, and Big Hidatsa).

Contain	Use Phase						Total/ Percent
	1	2	3	4	5	6	
Unknown			7	45		2	54 6.0
Uncontained	2	7	116	443	11	48	627 70.1
Contained Post/Pit	1		40	162	2	8	213 23.8
Total	3	7	163	650	13	58	894
Percent	.3	.8	18.2	72.7	1.5	6.5	100.0

Table 20. Cross-tabulation of feature type by use phase for bone tools from all three villages (Lower Hidatsa, Sakakawea, and Big Hidatsa).

Feature Type	Use Phase 1	2	3	4	5	6	Total/ Percent
General Level	2	7	121	485	11	50	676 75.6
Basin-Shaped Pit			1	5			6 .7
Flat Bottom Pit			1	2			3 .3
Post Mold			1	11		2	14 1.6
Undercut Pit	1		34	139	2	5	181 20.2
Ash Lens			1	7			8 .9
Other Aboriginal			4	1		1	6 .7
Total	3	7	163	650	13	58	894
Percent	.3	.8	18.2	72.7	1.5	6.5	100.0

concentrated in general levels and undercut pits. Also, no significant differences in use phase percentages between general levels and pit features could be detected. Feature types other than undercut pits are poorly represented in the bone assemblage provenience. This is especially true of basin shaped and flat bottomed pits, which are generally low in frequency. Post molds are quite common, but are small and contain few artifacts of any kind.

<u>House Area by Use Phase</u>

The examination of house area as related to use phase for the entire assemblage is tabulated in Table 21. This relationship is explored in order to determine if there are any significant differences in use phase distribution between inside and outside house contexts. As foreshadowed in previous tables, there is little difference in use phase percentages between the two contexts, despite a smaller inside-house sample. Trash disposal occurred primarily in undercut pits within the house, and in open midden areas outside, with similar items being discarded. These items were predominantly broken, exhausted artifacts. Post-depositional alteration of outside-house midden deposits was less significant than had originally been believed.

Components

Much of the remaining discussion of analysis results will focus on changes in assemblage composition through time with reference to the fur trade. The means for conducting such analyses lie in the

Table 21. Cross-tabulation of house area by use phase for bone tools from all three villages (Lower Hidatsa, Sakakawea, and Big Hidatsa).

House Area	Use Phase						Total/
	1	2	3	4	5	6	Percent
Unknown			11	69		4	84 9.4
Outside House	1	7	127	459	11	46	651 72.8
Inside House Roof			5	12		3	20 2.2
Inside-Floor & Feat.	2		20	110	2	5	139 15.5
Total Percent	3 .3	7 .8	163 18.2	650 72.7	13 1.5	58 6.5	894 100.0

construction of components for each site. Components were assigned for each site on the basis of stratigraphic associations, artifact content, and historic records. They have been discussed in detail in an earlier chapter and the criteria for their definition will not be repeated here. This section will present the bone tool assemblages from each site as related to those components originally defined in the technical reports. Then, the components from each site will be condensed as necessary, and mixed components will be deleted in order to provide a clearer picture of assemblage change through time. Discussion of assemblage change through time will then be undertaken using the condensed components. Metal/stone modification, and predominant method of manufacture will then be examined for each site with reference to the condensed components. In all following tables where components are mentioned by number, they are numbered from left to right on the page.

Lower Hidatsa Original Components

Cross-tabulation of tool types by original components for the 293 artifacts from the Lower Hidatsa site is presented in Table 22. A total of 12 components have been identified. Components 1-7 are from the 1978 UND/NPS excavations. Component 7 (mixed) consists of surface materials, and those artifacts from mixed or disturbed contexts. Components 8-12 are all from Lehmer's two test units in the southern portion of the site. The time periods for Lehmer's materials are more broad than those for the UND/NPS units, although

Table 22. Cross-tabulation of tool types by components as originally defined for Lower Hidatsa village (32ME10).

Tool Type	Component												Total/ Percent
	1740-1760	1700-1740	1650-1700	1600-1650	1525-1600	1450-1525	1450-1780 Mixed	1700-1780 Lehmer	1600-1700 Lehmer	1450-1600 Lehmer	1450-1700 Lehmer	1450-1600 Lehmer	
Split Ribs	2	6	8	8	4	2	3		3	1	1		38 13.0
Slotted Ribs/ Unknown Blade			1										1 .3
Slotted Ribs/ Metal Blade	1	1	3				1	3	1				10 3.4
Slotted Ribs/ Stone Blade			1						1				2 .7
Perforated Ribs	2		1			2	2		1	1	1		10 3.4
Dorsal Spines		1											1 .3
Scapula Hoes	1	6		3	3		1		2	1			17 5.8
Scapula Knives						1	1			1			3 1.0
Scapula Hide Wringers				1	1	1							3 1.0
Scapula Spines		5	2	1	2	1							11 3.8
Scapula Fragments	3	6	8	7	2	3	6	3	2	1			41 14.0
Antler Tines	2		1	2	1	1	1					1	9 3.1
Antler Beams				2	1	1							4 1.4
Antler Strips				2									2 .7
Antler Needles				1	1								2 .7
Antler Debris		3	3	4	1	2			1				14 4.8
Awls	1	1		1	2	1							6 2.0
Metapodial Awls				1			1			1			3 1.0

Table 22, cont'd.

Tool Type	Component 1740–1760	1700–1740	1650–1700	1600–1650	1525–1600	1450–1525	1450–1780 Mixed	1700–1780 Lehmer	1600–1700 Lehmer	1450–1600 Lehmer	1450–1700 Lehmer	1450–1600 Lehmer	Total/ Percent
Rib Awls			1										1 .3
Splinter Awls		2	2	1	1	2			1				9 3.1
Fleshers		1		1	1	1				2			6 2.0
Cancellous Tools		1		2	1								4 1.4
Fish Hooks		2											2 .7
Tubes-Beads			1										1 .3
Complete Tubes		2	5	1	1	1	1		3	1			15 5.1
Split Tubes		2	2	1	1	4							10 3.4
Perforated Fish Vertebrae		1			1								2 .7
Expedient Tools/ Shaft	3	5		3	1		1						13 4.4
Expedient Tools Articular		1	1										2 .7
Expedient Tools/ Rib	1		3	3		1		1					9 3.1
Manuf. Debris	1	1	3	1		2			3				11 3.8
Polished Fragments	3	2	4	2	2	7	2						22 7.5
Ochre Stained Bone		1	1										2 .7
Ornaments			1				1		1				3 1.0
Unique Objects			3			1							4 1.4
Total Percentage	20 6.8	50 17.1	55 18.8	48 16.4	27 9.2	34 11.6	21 7.2	7 2.4	19 6.5	9 3.1	2 .7	1 .3	293 100.0

they follow the same general chronological sequence. Finer division is not possible, given Lehmer's excavation techniques and lack of screening. This is evident in the distribution of artifacts in Lehmer's test units, which show predominantly formal tools, and a lack of artifacts such as polished fragments or expedient tools. The UND/NPS components offer the best chronological control, and will be examined in more detail below.

Sakakawea Original Components

Cross-tabulation of tool types by original components for the 211 tools from the Sakakawea site is presented in Table 23. The final results are different from those at Lower Hidatsa, in that it was possible to integrate Lehmer's 1965 materials into the analysis with the UND/NPS materials. Component 3 (1795-1800) was delineated in an effort to isolate the early burned houses, which represent the first village at the Sakakawea location. They may represent the Mandan village witnessed by Thompson in 1797/98. Components 1 (1815-1837) and 2 (1800-1815) are stratified units for the latter part of the occupation, constituting the village observed by most explorers, and the bulk of the site as recognized today. Components 4 (1800-1837) and 5 (1795-1837) are those items which could not be assigned to the stratified, unmixed components above. This is especially true of those materials in component 5 (1795-1837), which originate predominately on the surface and on the beach at the base of the cutbank.

Table 23. Cross-tabulation of tool types by component as originally defined for Sakakawea village (32ME11).

Tool Type	Component 1815-1837	1800-1815	1795-1800	1800-1837	1795-1837	Total/ Percent
Split Ribs	1			2		3 1.4
Slotted Ribs/ Unknown Blade	1					1 .5
Slotted Ribs/ Metal Blade	1	1	2			4 1.9
Perforated Ribs		2	1			3 1.4
Scapula Hoes	2	2	1	6	4	15 7.1
Scapula Knives	1	4			1	6 2.8
Scapula Hide Wringers				1		1 .5
Scapula Fragments	24	18	6	12	14	74 35.1
Antler Tines	4	1			3	8 3.8
Antler Strips	1					1 .5
Antler Debris			4	2		6 2.8
Antler Ice Glider					1	1 .5
Metapodial Awls		1				1 .5
Rib Awls		1				1 .5

Table 23, cont'd.

	Component					Total/ Percent
	1815-1837	1800-1815	1795-1800	1800-1837	1795-1837	
Scapula Awls		1				1 .5
Fleshers	1				1	2 .9
Cancellous Tools	1	1	1			3 1.4
Complete Tubes	3	2		1	4	10 4.7
Split Tubes	2	3		2	2	9 4.3
Expedient Tools/Shaft	2			1	1	4 1.9
Expedient Tools/ Articular		4		1	1	6 2.8
Expedient Tools/Rib	4	3	1		3	11 5.2
Expedient Tools/ Scapula				1		1 .5
Manuf. Debris	3	1		2	1	7 3.3
Polished Fragments	8	6		6	4	24 11.4
Ochre Stained Bone				1		1 .5
Ornaments	2	1			1	4 1.9
Unique Objects	2			1		3 1.4
Total Percent	63 29.9	52 24.6	16 7.6	39 18.5	41 19.4	211 100.0

Big Hidatsa Original Components

Cross-tabulation of tool types by original components for the 390 modified bone artifacts from the Big Hidatsa site is presented in Table 24. This site has by far the largest collection of modified bone, and the longest occupation of the three villages, allowing construction of a detailed sequence of components. The process of component construction for this site has been described in an earlier chapter. All of the materials presented in Table 24 were excavated during the UND project in 1980. Components 1-7 are sequential, representing an unbroken occupation from 1600-1845. They have all been developed from the results of material recovered in 1 x 2m excavation units. The exception is component 7, which dates to 1400-1500, and is chronologically separated from the rest of the occupation by a 100 year time span. This component is present only in AC Unit 6, located in the northern periphery. It is represented by only two artifacts, which is unfortunate since it is clearly pre-contact and could have provided valuable comparative material. Components 9 and 10 are mixed components, containing materials which could not be assigned to the components described above. There are few artifacts in these components, and they are not crucial to the interpretation of assemblage change through time.

Condensed Components

Tables 22-24 illustrate tool types cross-tabulated by the components originally defined for the entire collection at each

Table 24. Cross-tabulation of tool types by component as originally defined for Big Hidatsa village (32ME12).

Tool Type	Component 1830-1845	1790-1830	1745-1790	1700-1745	1650-1700	1600-1650	1400-1500	Mixed Village	Mixed 4-6	Total/ Percent
Split Ribs		3	6	3	4	1	1	1	1	20 5.1
Split Dorsal Spines		1								1 .3
Slotted Ribs/Unknown Blade		2								2 .5
Slotted Ribs/Metal Blade		3	1	1	1					6 1.5
Perforated Ribs		2								2 .5
Dorsal Spines			1	1						2 .5
Scapula Hoes	1	20	1	5	2	3			1	33 8.5
Scapula Knives		3	6	1						10 2.6
Scapula Hide Wringers		2	1	1						4 1.0
Scapula Spines		1	2							3 .8
Scapula Fragments	2	22	26	14	11	6	1	4	3	89 22.8
Horn Core/Frontal Tools			1	1						2 .5
Antler Tines	1	2	2	2						7 1.8
Antler Beams						1				1 .3
Antler Strips		1	3	2	1					7 1.8
Antler Needles						1		1		2 .5
Antler Debris		2	10	1	2			1		16 4.1

Table 24, cont'd.

Tool Type	Component 1830–1845	1790–1830	1745–1790	1700–1745	1650–1700	1600–1650	1400–1500	Mixed Village	Mixed 4–6	Total/ Percent
Awls					2	1			1	4 1.0
Metapodial Awls						1				1 .3
Rib Awls			1	1		1				3 .8
Splinter Awls			1	1	1					3 .8
Fleshers		2	2					1		5 1.3
Cancellous Tools		2	2							4 1.0
Fish Hooks			1	2	2					5 1.3
Complete Tubes		2	7	3	4	1				17 4.4
Split Tubes		2	1	5	1					9 2.3
Perforated Fish Vertebrae					1					1 .3
Whistles		1								1 .3
Expedient Tools/Shaft	3	1	4	3		1			1	13 3.3
Expedient Tools/Articular		1								1 .3
Expedient Tools/Rib	5	10	7	3	2					27 6.9
Manuf. Debris	1	3	7	5	7	1		1		25 6.4
Polished Fragments	6	5	21	7	8	6			2	55 14.1
Ornaments						1				1 .3
Unique Objects		2	1	2	2	1				8 2.1
Total Percent	19 4.9	95 24.4	115 29.5	64 16.4	51 13.1	26 6.7	2 .5	9 2.3	9 2.3	390 100.0

site. Problems with this scheme are evident. They include poor chronological control over the Lehmer collections at Lower Hidatsa, and mixed components at all three sites. All of these components tend to introduce extraneous information into the analysis. It is therefore necessary to delete some components, and concentrate on those with good chronological control, developed using consistent recovery and analysis procedures. This section will present condensed components for each site, and the rationale for their retention in the analysis. Chronological trends in the assemblages will then be examined for each site.

Lower Hidatsa

At Lower Hidatsa, an obvious choice in condensation of components was to delete mixed component 7, comprising 7.2% of the assemblage. It would have added little to the analysis, since the materials could not be assigned to clear components. A much more difficult choice concerns the Lehmer collections, components 8-12. The decision was made to eliminate all of these collections, or 13% of the total, in view of their poor chronological control and recovery procedures. There are obvious disadvantages to this course of action, since it results in the loss of many formal tools. However, it has the advantage of retaining only those collections with good stratigraphic control, gathered using consistent recovery procedures.

The cross-tabulation of tool types by condensed components for the Lower Hidatsa site is presented in Table 25. Components 1-6 are

Table 25. Cross-tabulation of tool types by component as condensed for this study, Lower Hidatsa village (32NE10).

Tool Type	Component 1740-1780	1700-1740	1650-1700	1600-1650	1525-1600	1450-1525	Total/ Percent
Split Ribs	2	6	8	8	4	2	30 12.8
Slotted Ribs/ Unknown Blade			1				1 .4
Slotted Ribs/ Metal Blade	1	1	3				5 2.1
Slotted Ribs/ Stone Blade			1				1 .4
Perforated Ribs	2		1			2	5 2.1
Dorsal Spines		1					1 .4
Scapula Hoes	1	6		3	3		13 5.6
Scapula Knives						1	1 .4
Scapula Hide Wringers				1	1	1	3 1.3
Scapula Spines		5	2	1	2	1	11 4.7
Scapula Fragments	3	6	8	7	2	3	29 12.4
Antler Tines	2		1	2	1	1	7 3.0
Antler Beams				2	1	1	4 1.7
Antler Strips				2			2 .9
Antler Needles				1	1		2 .9
Antler Debris		3	3	4	1	2	13 5.6
Awls	1	1		1	2	1	6 2.6

Table 25, cont'd.

Tool Type	Component						Total/ Percent
	1740-1780	1700-1740	1650-1700	1600-1650	1525-1600	1450-1525	
Metapodial Awls				1			1 .4
Rib Awls			1				1 .4
Splinter Awls		2	2	1	1	2	8 3.4
Fleshers		1		1	1	1	4 1.7
Cancellous Tools		1		2	1		4 1.7
Fish Hooks		2					2 .9
Tubes-Beads			1				1 .4
Complete Tubes		2	5	1	1	1	10 4.3
Split Tubes		2	2	1	1	4	10 4.3
Perforated Fish Vertebrae		1			1		2 .9
Expedient Tools/ Shaft	3	5		3	1		12 5.1
Expedient Tools/ Articular		1	1				2 .9
Expedient Tools/ Rib	1		3	3		1	8 3.4
Manuf. Debris	1	1	3	1		2	8 3.4
Polished Fragments	3	2	4	2	2	7	20 8.5
Ochre Stained		1	1				2 .9
Ornaments			1				1 .4
Unique Objects			3			1	4 1.7
Total Percent	20 8.5	50 21.4	55 23.5	48 20.5	27 11.5	34 14.5	234 100.0

retained, representing a continuous occupation from 1450 until abandonment after the smallpox epidemic of 1780. Some temporal trends in the assemblage are visible. Knife handles slotted for metal blades are present only after 1650, and scapula hoes are present throughout the occupation, although in low frequencies. Awls are low in frequency, but are present throughout the occupation. Much the same pattern of consistency can be observed in bone tube frequencies. Expedient tools are also present throughout the occupation, with a slight increase in frequency toward the end. Only one ornament was recovered from the site matrix. The other bone tool types show little temporal variation.

Sakakawea

In the Sakakwea assemblage, material from Lehmer's excavations has been integrated into the analysis, in a manner not possible at Lower Hidatsa. In this case, mixed components 4 and 5 have been eliminated, leaving unmixed components 1-3. This still leaves material from the entire site occupation of 1795-1837. A cross-tabulation of tool type by these three components is presented in Table 26. The components illustrate the earliest burned houses at the site (1795-1800), followed by two stratigraphic units dividing the remainder of the 1800-1837 period.

Some observations can be made from examination of Table 26. Knife handles slotted for metal blades are present throughout the occupation. Awls and expediency tools are present, but are low in

Table 26. Cross-tabulation of tool types by component as condensed for this study, Sakakawea village (32ME11).

Tool Type	Component 1815–1837	1800–1815	1795–1800	Total/Percent
Split Ribs	1			1 .8
Slotted Ribs/ Unknown Blade	1			1 .8
Slotted Ribs/ Metal Blade	1	1	2	4 3.1
Perforated Ribs		2	1	3 2.3
Scapula Hoes	2	2	1	5 3.8
Scapula Knives	1	4		5 3.8
Scapula Fragments	24	18	6	48 36.6
Antler Tines	4	1		5 3.8
Antler Strips	1			1 .8
Antler Debris			4	4 3.1
Metapodial Awls		1		1 .8
Rib Awls		1		1 .8
Scapula Awls		1		1 .8
Fleshers	1			1 .8

Table 26, cont'd.

Tool Type	Component 1815-1837	1800-1815	1795-1800	Total/ Percent
Cancellous Tools	1	1	1	3 2.3
Complete Tubes	3	2		5 3.8
Split Tubes	2	3		5 3.8
Expedient Tools/ Shaft	2			2 1.5
Expedient Tools/ Articular		4		4 3.1
Expedient Tools/ Rib	4	3	1	8 6.1
Manuf. Debris	3	1		4 3.1
Polished Fragments	8	6		14 10.7
Ornaments	2	1		3 2.3
Unique Objects	2			2 1.5
Total Percent	63 48.1	52 39.7	16 12.2	131 100.0

frequency, as are ornaments and tubes. The other tool types exhibit no clear chronological patterns. Sakakawea was occupied for a fairly short time, during which the Hidatsa were heavily involved as middlemen in the fur trade. The implications of these activities will be discussed below.

Big Hidatsa

The condensation of components at Big Hidatsa is in many ways the easiest to accomplish for the three sites. The occupation is quite long, and good chronological control is possible. Analysis will be performed after deletion of only mixed components 9 and 10, resulting in the loss of only 18 artifacts out of 390.

Cross-tabulation of tool types by condensed components at Big Hidatsa is presented in Table 27, and some changes through time can be observed. Knife handles slotted for metal blades are present only after 1650. Scapula hoes are present in all but the earliest component, and show a steady increase, up until the latest component. There is a parallel increase in scapular fragments as well. Awls are low in number, and are not present after 1790 in any of the units. Tubes are present all but the earliest and latest periods, and a steady increase in expedient tools up through the latest levels can be observed. Ornaments are rare, being represented by only one specimen. Significant chronological changes in the other tool types could not be documented.

Table 27. Cross-tabulation of tool types by component as condensed for this study, Big Hidatsa village (32ME12).

Tool Type	Component 1830–1845	1790–1830	1745–1790	1700–1745	1650–1700	1600–1650	1400–1500	Total/ Percent
Split Ribs		3	6	3	4	1	1	18 4.8
Split Dorsal Spines		1						1 .3
Slotted Ribs/ Unknown Blade		2						2 .5
Slotted Ribs/ Metal Blade		3	1	1	1			6 1.6
Perforated Ribs		2						2 .5
Dorsal Spines			1	1				2 .5
Scapula Hoes	1	20	1	5	2	3		32 8.6
Scapula Knives		3	6	1				10 2.7
Scapula Hide Wringers		2	1	1				4 1.1
Scapula Spines		1	2					3 .8
Scapula Fragments	2	22	26	14	11	6	1	82 22.0
Horn Core/ Frontal Tools			1	1				2 .5
Antler Tines	1	2	2	2				7 1.9
Antler Beams						1		1 .3
Antler Strips		1	3	2	1			7 1.9
Antler Needles						1		1 .3
Antler Debris		2	10	1	2			15 4.0
Awls					2	1		3 .8

Table 27, cont'd

Tool Type	Component 1830-1845	1790-1830	1745-1790	1700-1745	1650-1700	1600-1650	1400-1500	Total/ Percent
Metapodial Awls						1		1 .3
Rib Awls			1	1		1		3 .8
Splinter Awls			1	1	1			3 .8
Fleshers		2	2					4 1.1
Cancellous Tools		2	2					4 1.1
Fish Hooks			1	2	2			5 1.3
Complete Tubes		2	7	3	4	1		17 4.6
Split Tubes		2	1	5	1			9 2.4
Perforated Fish Vertebrae					1			1 .3
Whistles		1						1 .3
Expedient Tools/ Shaft	3	1	4	3		1		12 3.2
Expedient Tools/ Articular		1						1 .3
Expedient Tools/ Rib	5	10	7	3	2			27 7.3
Manuf. Debris	1	3	7	5	7	1		24 6.5
Polished Fragments	6	5	21	7	8	6		53 14.2
Ornaments						1		1 .3
Unique Objects		2	1	2	2	1		8 2.2
Total Percent	19 5.1	95 25.5	115 30.9	64 17.2	51 13.7	26 7.0	2 .5	372 100.0

Other Measures of Change

The cross-tabulations of tool types by condensed components for each site as presented in Tables 25-27 are useful for illustrating some assemblage variability through time. However, it is difficult to see many patterns in the materials. Therefore, the remainder of this chapter will examine tool variables for each site, with reference to condensed components. First, metal/stone modification will be cross-tabulated by condensed components for each site, followed by a similar examination of predominant method of manufacture for each site.

Metal/Stone Modification

A cross-tabulation of metal/stone modification by component at the Lower Hidatsa site is presented in Table 28. Most of the artifacts (87.6%) have been coded as having indeterminate metal/stone modification. The earliest indication of metal modification is a single artifact in component 5 (1525-1600). This artifact is a fragmentary scapula hoe which exhibits faint cut marks that might have been produced by a metal cutting edge. The important factor here is the possibility of metal presence prior to 1600, even if only in the form of a single artifact. In component 4 (1600-1650), there are two artifacts, a flesher and a piece of antler manufacturing debris, which show convincing evidence of metal modification. There is a small but consistent percentage of metal-modified bone tools in the occupation after that point. Bone tools

Table 28. Cross-tabulation of metal/stone modification by component as condensed for this study, Lower Hidatsa village (32ME10).

Modification	Component						Total/ Percent
	1740-1780	1700-1740	1650-1700	1600-1650	1525-1600	1450-1525	
Indeterminate	18	47	45	40	24	31	205 87.6
Stone		1	5	6	2	3	17 7.3
Metal	2	2	5	2	1		12 5.1
Total Percent	20 8.5	50 21.4	55 23.5	48 20.5	27 11.5	34 14.5	234 100.0

modified with stone are present in the earliest stages of the occupation in small numbers, and continue to show a presence until the latest component, where they are absent. This lack of stone modification is difficult to interpret, given the small sample size, but may indicate less modification of bone with stone tools as metal became available.

A cross-tabulation of metal/stone modification by condensed component for the Sakakawea site is presented in Table 29. The sample at Sakakawea is small, but as is the case at Lower Hidatsa, the majority of tools (77.9%) have been coded as having indeterminate metal/stone modification. Metal modification is present in all components, which would be expected given the time of site occupation. Bone tools modified with metal are present in all three components, and show an increase in the latest (1815-1837). Only six artifacts modified with stone have been identified, and show no identifiable pattern.

A cross-tabulation of metal/stone modification by condensed component for the Big Hidatsa site is presented in Table 30. As at the other sites, a majority of bone tools (71.2%) has been identified as having indeterminate metal/stone modification. Of those identified as having been modified with metal, none are present in component 7 (1400-1500), but one appears in component 6 (1600-1650). It is an antler beam which exhibits clear metal cut marks. This establishes that metal could have been present at Big Hidatsa as early as 1600. The number of metal modified artifacts increases through time, even when larger sample sizes later in time

Table 29. Cross-tabulation of metal/stone modification by component as condensed for this study, Sakakawea village (32ME11).

Modification	Component 1815-1837	Component 1800-1815	Component 1795-1800	Total/ Percent
Indeterminate	50	40	12	102 77.9
Stone	2	4		6 4.6
Metal	11	8	4	23 17.6
Total	63	52	16	131
Percent	48.1	39.7	12.2	100.0

Table 30. Cross-tabulation of metal/stone modification by component as condensed for this study, Big Hidatsa village (32ME12).

Modification	Component							Total/ Percent
	1830-1845	1790-1830	1745-1790	1700-1745	1650-1700	1600-1650	1400-1500	
Indeterminate	16	64	85	45	32	21	2	265 71.2
Stone		8	22	11	17	4		62 16.7
Metal	3	23	8	8	2	1		45 12.1
Total	19	95	115	64	51	26	2	372
Percent	5.1	25.5	30.9	17.2	13.7	7.0	.5	100.0

are considered. The highest level is reached in component 2 (1790-1830), where 24% of the sample is modified with metal tools. Bone tools modified with stone are present through all of the occupation, although a peak percentage is reached earlier in time, 33% in component 6 (1650-1700). Stone modification of bone tools does not disappear late in the occupation as metal tools become widely available.

Predominant Method of Manufacture

Predominant method of manufacture will be examined in the context of condensed components for each site in an effort to determine if any clear patterning is present. This is an important point, in that most scoring/splitting processes are done with stone tools, while many chopping/grinding operations are performed at least partially with metal tools.

A cross-tabulation of predominant method of manufacture by condensed components for the Lower Hidatsa site is presented in Table 31. No clear pattern can be detected among manufacture methods and components. There is a slight increase in chopping/grinding after 1600. This method of manufacture is closely associated with scapula tools and may reflect an increase in that category. Breakage is associated with expedient tools, but this category shows no clear pattern of variability.

A cross-tabulation of predominant method of manufacture by condensed components for the Sakakawea site is presented in Table

Table 31. Cross-tabulation of predominant method of manufacture by component as condensed for this study, Lower Hidatsa village (32ME10).

Predominant Manufacture	Component						Total/ Percent
	1740-1780	1700-1740	1650-1700	1600-1650	1525-1600	1450-1525	
N/A	5	5	12	9	5	11	47 20.1
Scoring-Splitting	4	21	24	19	13	14	95 40.6
Chopping-Grinding	7	17	14	15	8	8	69 29.5
Breakage	4	7	5	5	1	1	23 9.8
Total Percent	20 8.5	50 21.4	55 23.5	48 20.5	27 11.5	34 14.5	234 100.0

32. As was the case at Lower Hidatsa, there is little evidence of patterning among the methods of manufacture and the three components. Scoring/splitting is low in frequency, probably reflecting the low number of awls in the collection. There is a slight increase in chopping/grinding through time, but it parallels increases in sample size. Breakage likewise shows no significant pattern of variability.

A cross-tabulation of predominant method of manufacture by condensed components for the Big Hidatsa site is presented in Table 33. As was the case with Lower Hidatsa and Sakakawea, there is little in the way of identifiable patterning. There is a slight increase in chopping/grinding, while scoring/splitting stays much the same through time. There is a slight increase in tools modified by breakage through time, reflecting the increase in expedient tools.

Combined Site Assemblages

The information presented thus far for individual sites has yielded some patterns, such as the low frequencies of awls, the consistent presence of expedient tools, and the earliest indications of metal by 1600. However, it is difficult to detect all broad trends from three different assemblages. Therefore, this section will present a condensation of all three site assemblages into one sequence. There are problems with this approach, chief among them, the compression of two distinct Hidatsa subgroups from three villages into one sequence. This disadvantage is however, offset by

Table 32. Cross-tabulation of predominant method of manufacture by component as condensed for this study, Sakakawea village (32ME11).

Predominant Manufacture	Component 1815-1837	Component 1800-1815	Component 1795-1800	Total/ Percent
N/A	17	7	4	28 21.4
Scoring-Splitting	8	8		16 12.2
Chopping-Grinding	32	30	11	73 55.7
Breakage	6	7	1	14 10.7
Total Percent	63 48.1	52 39.7	16 12.2	131 100.0

Table 33. Cross-tabulation of predominant method of manufacture by component as condensed for this study, Big Hidatsa village (32ME12).

Predominant Manufacture	Component							Total/ Percent
	1830-1845	1790-1830	1745-1790	1700-1745	1650-1700	1600-1650	1400-1500	
N/A	7	10	31	13	11	10		82 22.0
Scoring-Splitting	1	14	31	21	23	6	1	97 26.1
Chopping-Grinding	3	59	43	24	15	9	1	154 41.4
Breakage	8	12	10	6	2	1		39 10.5
Total Percent	19 5.1	95 25.5	115 30.9	64 17.2	51 13.7	26 7.0	2 .2	372 100.0

the information to be gained from a single combined sequence for Lower Hidatsa, Sakakawea, and Big Hidatsa villages.

Components for the combined sequence have been taken from each site. In many cases, the components have identical, or very similar time spans. If two components with differing time limits were combined, the larger range was used. Special mention shoul be made of the period 1790-1837, which contains all the Sakakawea materials. The resulting sequence will be examined from several perspectives in this section.

Tooltype by Component

A cross-tabulation of the entire assemblage (derived from condensed components at all three sites) is presented in Table 34. Assemblage change through time is now discernable. Split ribs maintain a roughly constant presence. Knife handles slotted for metal blades do not appear before 1650, but increase after that through the period 1790-1837. Scapula tools are a major category, present in significant quantities. Scapula hoes show a consistent increase through time, as do scapula fragments, most of which probably came from hoes. Other scapula tools, such as knives and hide wringers show a relatively constant presence. Antler tools show some differences through time. Antler beams and needles disappear early in the sequence, while the other categories, tines and debris, continue to be represented. Awls of all types exhibit low frequencies for the duration of the occupation. However, they

Table 34. Cross-tabulation of tool types by condensed components for all three villages (Lower Hidatsa, Sakakawea, and Big Hidatsa).

Tool Type	Component								Total/ Percent
	1400–1450	1525–1600	1600–1650	1650–1700	1700–1750	1740–1790	1790–1837	1830–1845	
Split Ribs	3	4	9	12	9	8	4		49 6.6
Split Dorsal Spines							1		1 .1
Slotted Ribs/ Unknown Blade				1			3		4 .5
Slotted Ribs/ Metal Blade				4	2	2	7		15 2.0
Slotted Ribs/ Stone Blade				1					1 .1
Perforated Ribs	2			1		2	5		10 1.4
Dorsal Spines					2	1			3 .4
Scapula Hoes		3	6	2	11	2	25	1	50 6.8
Scapula Knives	1				1	6	8		16 2.2
Scapula Hide Wringers	1	1	1		1	1	2		7 .9
Scapula Spines	1	2	1	2	5	2	1		14 1.9
Scapula Fragments	4	2	13	19	20	29	70	2	159 21.6
Horn Core/ Frontal Tools					1	1			2 .3
Antler Tines	1	1	2	1	2	4	7	1	19 2.6
Antler Beams	1	1	3						5 .7
Antler Strips			2	1	2	3	2		10 1.4
Antler Needles		1	2						3 .4
Antler Debris	2	1	4	5	4	10	6		32 4.3
Awls	1	2	2	2	1	1			9 1.2
Metapodial Awls			2				1		3 .4
Rib Awls			1	1	1	1	1		5 .7

Table 34, cont'd.

Tool Type	Component 1400–1450	1525–1600	1600–1650	1650–1700	1700–1750	1740–1790	1790–1837	1830–1845	Total/ Percent
Splinter Awls	2	1	1	3	3	1			11 1.5
Scapula Awls							1		1 .1
Fleshers	1	1	1		1	2	3		9 1.2
Cancellous Tools		1	2		1	2	5		11 1.5
Fish Hooks				2	4	1			7 .9
Tubes-Beads				1					1 .1
Complete Tubes	1	1	2	9	5	7	7		32 4.3
Split Tubes	4	1	1	3	7	1	7		24 3.3
Perforated Fish Vertebrae		1		1	1				3 .4
Whistles							1		1 .1
Expedient Tools/ Shaft		1	4		8	7	3	3	26 3.5
Expedient Tools/ Articular				1	1		5		7 .9
Expedient Tools/ Rib	1		3	5	3	8	18	5	43 5.8
Manuf. Debris	2		2	10	6	8	7	1	36 4.9
Polished Fragments	7	2	8	12	9	24	19	6	87 11.8
Ochre Stained Bone				1	1				2 .3
Ornaments			1	1			3		5 .7
Unique Objects	1		1	5	2	1	4		14 1.9
Total Percent	36 4.9	27 3.7	75 10.0	106 14.4	114 15.5	135 18.3	226 30.7	19 2.6	737 100.0

are present throughout, even during times when substantial amounts of metal were available. Fleshers, cancellous tools, and tubes/beads also show a low frequency, but consistent presence throughout the occupation. Expedient tools are also present throughout the occupation and they show a rather clear increase near the end of the occupation. Manufacturing debris, polished fragments, and unique objects exhibit no clear patterns. Ornaments are rare, but three are present in the period 1790-1837, when large quantities of Euro-American substitute ornaments were available.

General Tool Categories by Component

Changes in assemblage structure through time can be observed in an even more general manner. This is accomplished by cross-tabulating general tool categories by components for the entire assemblage (Table 35).

Many of the same patterns as seen in specific tool types can also be seen in the general tool categories. The clear increase in scapula tools, and the steady to slight increase in antler tools are both visible. Awls are again seen as present throughout the occupation in low frequencies, and the same is true for fleshers and cancellous tools. Also, expedient tools are present throughout the occupation, and show a steady increase through time. The other general tool categories in Table 35 show little chronological change.

Table 35. Cross-tabulation of general tool categories by condensed components for all three villages (Lower Hidatsa, Sakakawea, and Big Hidatsa).

General Tool Categories	Component								Total/ Percent
	1400–1450	1525–1600	1600–1650	1650–1700	1700–1750	1740–1790	1790 1837	1830–1845	
Split Ribs	3	4	9	12	9	8	5		50 6.8
Slotted Ribs				6	2	2	10		20 2.7
Perforated Ribs	2			1		2	5		10 1.4
Dorsal Spines					2	1			3 .4
Scapula Tools	7	8	21	23	38	40	106	3	246 33.4
Horn Core/ Frontal Tools					1	1			2 .3
Antler Tools	4	4	13	7	8	17	15	1	69 9.4
Awls	3	3	6	6	5	3	3		29 3.9
Fleshers	1	1	1		1	2	3		9 1.2
Cancellous Tools		1	2		1	2	5		11 1.5
Fish Hooks				2	4	1			7 .9
Tubes-Beads	5	3	3	14	13	8	15		61 8.3
Expedient Tools	1	1	7	6	12	15	26	8	76 10.3
Manuf. Debris	2		2	10	6	8	7	1	36 4.9
Polished Fragments	7	2	8	12	9	24	19	6	87 11.8
Ochre Stained Bone				1	1				2 .3
Ornaments			1	1			3		5 .7
Unique Objects	1		1	5	2	1	4		14 1.9
Total Percent	36 4.9	27 3.7	74 10.0	106 14.4	114 15.5	135 18.3	226 30.7	19 2.6	737 100.0

Metal/Stone Modification by Component

The cross-tabulation of metal/stone modification by component for all three sites combined is presented in Table 36. Some of the same patterns observed in individual site assemblages are visible here. Metal modification is restricted to one specimen prior to 1600, that from Lower Hidatsa. From that low level, the percentage of bone tools modified with metal rises to a peak of 20% in the period 1790-1837. Stone modification is continuous throughout the occupation, with the exception of 1830-1845. Early in the occupation, the percentage of stone modification is larger than that for metal modification. That situation perisists until the period 1790-1837 when metal modification becomes prominent. A clear majority of the tools (77.6%) however, are coded as having indeterminate metal/stone modification.

Predominant Manufacture by Component

The cross-tabulation of predominant method of manufacture by component for all three sites is presented in Table 37. As was the case with metal/stone modification, some of the patterns observed previously are evident here. There is an increase in chopping/grinding through time in the assemblage, which is probably related to the general increase in scapula tools. The increase in breakage is also clearly related to the general increase in expedient tools. Scoring/splitting maintains a steady presence, and drops off in the latest period, which is related to the low frequencies of awls. In

Table 36. Cross-tabulation of metal/stone modification by condensed components for all three villages (Lower Hidatsa, Sakakawea, and Big Hidatsa).

Modification	Component								Total/ Percent
	1400–1450	1525–1600	1600–1650	1650–1700	1700–1750	1740–1790	1790–1837	1830–1845	
Indeterminate	33	24	61	77	92	103	166	16	572 77.6
Stone	3	2	10	22	12	22	14		85 11.5
Metal		1	3	7	10	10	46	3	80 10.9
Total Percent	36 4.9	27 3.7	74 10.0	106 14.4	114 15.5	135 18.3	226 30.7	19 2.6	737 100.0

Table 37. Cross-tabulation of predominant method of manufacture by condensed components for all three villages (Lower Hidatsa, Sakakawea, and Big Hidatsa).

Predominant Manufacture	Component								Total/ Percent
	1400-1450	1525-1600	1600-1650	1650-1700	1700-1750	1740-1790	1790-1837	1830-1845	
N/A	11	5	19	23	18	36	38	7	157 21.3
Scoring-Splitting	15	13	25	47	42	35	30	1	208 28.2
Chopping-Grinding	9	8	24	29	41	50	132	3	296 40.2
Breakage	1	1	6	7	13	14	26	8	76 10.3
Total Percent	36 4.9	27 3.7	74 10.0	106 14.4	114 15.5	135 18.3	226 30.7	19 2.6	737 100.0

retrospect, predominant method of manufacture as a variable has contributed little to the analysis. The manufacturing processes are tied to specific tool categories, and tend to echo information presented elsewhere.

Discussion

The preceding section has described the assemblage variability from the three villages as separate collections, and as a single unit. The following discussion will attempt to relate some of that variability to the advancing Euro-American fur trade.

The Indirect Trade period began in the Knife River by 1600, or shortly thereafter. This is certainly within the realm of possibility, since the Canadian outpost of Quebec was established by 1608, providing a source for trade materials. The Hidatsa received trade materials from other Indian groups until the mid-1700's, when Canadian traders made contact by traveling overland from the northeast. By the 1780's regular contacts had been established, and tenant traders were living among the Hidatsa and their neighbors.

The modified bone evidence for this Indirect Trade period is as follows. First, a single artifact from Lower Hidatsa shows evidence of metal modification prior to 1600. The identification of metal modification on this single artifact is unclear and open to interpretation. Also, the artifact may represent an intrusion, but it does suggest the presence of metal by 1600. Another argument for introduction of metal around 1600 comes from the low frequencies of awls. This category is quite large in pre-contact sites, but here it is represented by consistently low frequencies at all three sites. This suggests partial replacement of small piercing artifacts with metal substitutes by early in the 1600's. These small artifacts would have been the first to be replaced, since small metal items such as awls, or scraps from which awls could be made could have been easily traded through the established aboriginal trade system to the Hidatsa. Few expedient tool are present at this time. The other major tool types are all well represented.

The period 1650-1700 also represents the Indirect Trade period. The Hidatsa were still near the end point of the Euro-American fur trade system, which was being attatched to the existing aboriginal trade system. During this period, the first knife handles with metal blade slots appeared, providing indisputable evidence for the introduction of metal. Awls continued to be present in small quantities, and more metal cut marks are observed on bone tools.

The period 1700-1750 represents the late Indirect Trade period. Direct contact was established with La Vérendrye in 1738, but for the Hidatsa, the Indirect system was still prevalent. The trends established in the previous period continued, with knife handles exhibiting metal slots, more metal cut marks on bone tools, and and increase in expedient tools.

The period 1750-1790 marked the beginnings of the Middlemen Trade period for the Hidatsa. As discussed earlier, the Hidatsa found themselves between the advancing frontier of the gun to the northeast, and horse to the southwest, allowing them to prosper greatly through trade. These goods were incorporated into the trade system in which they had been active participants prior to contact. Despite the dislocations from epidemic disease, the Hidatsa were able to reap great prosperity from their role as middlemen. Canadian traders arrived regularly during this period, and tenant traders became relatively common. The modified bone assemblage continues to exhibit low frequencies of awls, and frequencies of metal modification similar to earlier periods. However, there is a considerable increase in scapula tools during this period. Scapula tools were almost entirely employed in agriculture, and an increase may mean that gardens were being expanded to meet the demands of the trade. There is also a size factor concerning scapula hoes. The iron hoes to replace the bone models were large and heavy, and difficult to transport to the area prior to reliable river transport from St. Louis. This may be one of the reasons for the persistence of scapula hoes throughout the occupation. An increase in expedient tools is also noted here. This is probably because metal substitutes were beginning to take over the functions of formal bone tools. Expedient tools had always been in the assemblage, but as contact progressed, they assumed greater importance.

The period 1790-1837 represents the late Middlemen Trade period, grading into the Direct Trade period. Direct Trade was established on an intermittent basis with temporary posts near the Knife River after the Lewis and Clark expedition, but it was not really put in place until the construction of Fort Clark in 1830-31.

Fort Clark undercut the Hidatsa's profitable middlemen role, and supplied a conduit for huge quantities of trade materials into the area and furs out to American and European markets. The bone assemblage during this period continues to show few awls, but a great increase in scapula tools, especially hoes. This would be expected, since there would have been even more need for garden produce to trade. More knife handles with metal slots appeared, and expedient tools continued to increase. During this period, expedient tools continued to grow in importance as metal tools took over functions previously satisfied by formal bone tools. There is a sharp increase in metal modification of bone tools as well during this period, providing evidence of more metal moving into the area.

The period 1830-1845 represents the last residence by the Hidatsa at the Knife River. The devastating smallpox epidemic of 1834 left all the river tribes as tattered remnants of their former selves. Survivors from all three tribes lived at Big Hidatsa from 1834 until 1845, when they moved upriver to live at Like-A-Fishhook village near Fort Berthold. Unfortunately, this period is represented by material from only one excavation unit at Big Hidatsa, and the sample of modified bone is too small to make any concrete statements.

Throughout the period of the fur trade, the Hidatsa developed economic dependence upon the traders as metal tools took the place of native bone tools. The implications of this growing dependence in light of the model of acculturation will be discussed in the final chapter.

CONCLUSIONS

In this chapter, the findings of the preceding sections will be reviewed and interpreted with reference to the changing structure of the fur trade during Euro-American contact. Changes in the modified bone assemblages will then be related to the process of acculturation.

This chapter will proceed as follows. First, the key points of the preceding chapter will be summarized, primarily in tabular form. Pertinent changes in the modified bone assemblages will be related to the stages in the fur trade as observed at the Knife River villages. Also, frequencies of trade artifacts will be tabulated in the same framework. Second, diffusion and acculturation will be discussed as related to the fur trade on the northern Plains, and a discussion of what can and cannot be derived from analysis of bone tools will be offered. The general social consequences of the introduction of new technology into the villages will then be discussed. Third, each component in the Hidatsa occupation at the Knife River villages will be examined, and the structure of the modified bone assemblage will be related to the fur trade activities of the time. Economic and social changes in the villages as reflected in the assemblages will also be discussed for each component. Finally, a concluding statement will be offered, assessing the merits of this type of modified bone analysis.

Assemblage Change By Component

Specific changes in the modified bone assemblages by component have been presented in some detail in the preceding chapter. The discussion included the derivation of components at each site, description of the condensation of components into one sequence, and examination of modified bone assemblage change from a variety of perspectives. That information will not be repeated here, but will be condensed into a single tabulation in order to provide the basis for summary discussions.

The information contained in Tables 34, 35, and 36 has been summarized and condensed into the sequence presented in Table 38. It shows the sequence of components, associated stages of the fur trade, and summarizes the most important modified bone assemblage characteristics for each. The assemblage changes through time as described earlier are visble. They include consistently low frequencies of awls and increases in modification of bone with metal, as well as increases in scapula tools and expedient tools. The information in Table 38 is obviously generalized, so reference should be made to the specific information in Tables 34-36.

The modified bone assemblage changes described in Table 38 are clearly related to the introduction of metal through the fur trade. With this in mind, a tabulation of metal objects and glass bead frequencies was undertaken (Table 39). This tabulation shows the frequencies of trade materials for each component as identified for the combined sequence. There are no trade items prior to 1600, and

Table 38. Components as condensed for all Knife River Villages along with trade periods and modified bone assemblage characteristics.

Component/ Trade Period	Modified Bone Assemblage Characteristics
1830-1845 Direct Trade	Small sample from one excavation unit at Big Hidatsa, no meaningful statements possible. Post-epidemic, joint residence by all River Tribes at Big Hidatsa.
1790-1837 Late Middlemen-Direct Trade	Maximium percentages of scapula tools, expedient tools, and knife handles with metal slots. Sharp increase in bone tools modified with metal, awls low in frequency. No definable patterns in other tool types.
1740-1790 Early Middlemen	Increase in scapula tools and expedient tools. Metal modification at levels similar to earlier periods, awls low in frequency. Knife handles with metal slots present. No definable patterns in other tool types.
1700-1750 Late Indirect	Increase in scapula tools over previous period, similar frequency as in subsequent period. Continued increase in expedient tools, awls present in low frequencies. Knife handles with metal slots present, slight increase in metal modification. No definable patterns in other tool types.
1650-1700 Middle Indirect	Slight decrease in scapula tools, including fewer hoes. Increase in expedient tools. Awls low in frequency, slight increase in metal modification, first appearance of knife handles slotted for metal blades. No definable patterns in other tool types.
1600-1650 Early Indirect	Slight increase in scapula tools, awls low in frequency. Increase in expedient tools, low frequency of metal modification, absence of knife handles slotted for metal blades. No definable patterns in other tool types.
1525-1600 Pre-contact/ Earliest Indirect	Scapula tools similar to previous and subsequent components. Awls low in frequency, absence of knife handles slotted for metal blades, one artifact modified with metal, one expedient tool. No definable patterns in other tool types.
1400-1525 Pre-Contact-Scattered Village Complex	Scapula tools similar to subsequent period, awls low in frequency. Absence of knife handles slotted for metal blades. Absence of metal modification. Awls low in frequency. One expedient tool. No definable patterns in other tool types.

Table 39. Frequencies of all metal artifacts and glass beads by condensed components for all three Knife River Villages.

Component/ Trade Period	Metal (Count)	Glass Beads (Count)	Total/ Percent
1830-1845 Direct Trade	242	737	979 13.9
1790-1837 Late Middlemen-Direct Trade	1670	2817	4487 63.6
1740-1790 Early Middlemen	652	204	856 12.1
1700-1750 Late Indirect	608	46	654 9.3
1650-1700 Middle Indirect	42	33	75 1.1
1600-1650 Early Indirect	3	4	7 0.1
1525-1600 Pre-Contact/ Earliest Indirect	0	0	0 0.0
1400-1525 Pre-Contact/ Scattered Village Complex	0	0	0 0.0
Total Percent	3217 45.6	3841 54.4	7058 100.0

only low frequencies until 1650. After 1650, there is a steady increase in both metal and beads, peaking in the Late Middlemen/ Direct Trade component (1790-1837). These data will be employed in the final discussions and conclusions.

Acculturation

Acculturation was the process of cultural change experienced by the Hidatsa in the Knife River villages during most of the fur trade. Diffusion was the operative process during the Indirect Trade period, prior to direct contact between the Hidatsa and Euro-American traders. Diffusion, and especially acculturation provide the means to illustrate what took place when a well developed and successful native culture came into contact with the expansionist Euro-American cultures of the 17th, 18th, and 19th centuries.

During the process of Euro-American contact, the native cultures of the Missouri Valley were altered, and finally almost destroyed. Disease was certainly a major factor, with devastating smallpox epidemics recorded in 1780-81 and 1837. Earlier epidemics can be inferred from a variety of sources. However, the influx of new technology also made a considerable contribution to changing the native cultures. During contact, cultural elements, including technology, went almost exclusively from the Euro-Americans to the Indians. With the notable exception of hardy strains of corn and beans, few cultural elements went the other way. There was a pattern of clear dominance by the Euro-Americans in the contact situation, especially late in the Hidatsa occupation in the Knife

River villages.

In this situation of contact, diffusion and acculturation, the artifacts left behind in archaeological sites are all that's available to work with. The historic documentation of the Hidatsa occupation during contact is very good, but it is the artifacts, bone tools in this case, which provide the detailed picture of change. During the process of acculturation, objects are accepted first, often without face to face contact between the two groups. Patterns of behavior, beliefs, concepts, and ideas change much more slowly. Elements lacking concrete expression in objects or overt behavior are the most difficult to document (Linton 1940:485).

In the Knife River Hidatsa case, long-term survival of concepts and ideas has been documented. The Mandan (and by extension, Hidatsa) ceremonial structure, beliefs, clan system, and age grade societies survived the fur trade period, up until 1862 (Bruner 1961:228-233). What finally broke up many of these institutions was forced allottment of the Fort Berthold Reservation in the 1880's. Material culture certainly changed dramatically as a result of the fur trade, even if other more abstract cultural elements did not (Bruner 1961:229). A good example of the tenacity and survival of cultural elements is the existence of a clan structure today on the Fort Berthold Reservation. The point here is that one can't really derive a picture of changes in abstract cultural institutions such as age-grade societies and clans from examination of bone tools. Even if it were possible, it might not illuminate much change, since many of those elements survived the fur trade period.

What can be derived from bone tool analysis is a picture of developing economic dependence by the Indians toward the traders, and from that to infer social disruptions. In an earlier chapter, the concepts of directed and non-directed contact were discussed. In directed contact, one group actively and purposefully interferes with the culture of another (Linton 1940:501-502). Thus the Spaniards in New Mexico were practicing directed contact in attempting to destroy Pueblo religion while forcing Catholicism on the people. In the Mandan/Hidatsa case, at least in the early fur trade period, trade was conducted by company representatives from Canada, and by tenant traders. The Canadian traders came to the villages on regular trading expeditions, stayed a short time, and returned to their forts in Canada. The tenant traders lived among the Indians for years, learned the language, and took Indian wives. Both types of traders were essentially isolated from their cultures, and lived subject to Indian law. In this regard, the fur trading companies apparently allowed the balance of power to stay with the Indians (Bruner 1961:215). For these reasons, Spicer (1961:522-523) believes that all of the fur trade period, up until 1862, was an example of non-directed contact.

The Hidatsa contact situation may not fit the definition for directed contact, but the traders were by no means passive in their dealings with the Indians. They were clearly dominant in the trade situation, and had their own motives, mostly related to profit and prestige, in dealing with the Indians. The traders believed themselves to be superior to the Indians, and attempted at all times to maintain that role (Saum 1965). The Indians themselves saw the traders as very powerful, and used a culturally sanctioned means for acquiring that power. The path to power dictated that Indian men offer their wives to the traders, believing that the trader's power could be passed to them through their wives by means of sexual intercourse. This practice was grossly misunderstood by the traders, who assumed all Mandan and Hidatsa women to be prostitutes (Bruner 1961:216-217). This situation of perceived power and dominance would have led the traders to manipulate the situation to their advantage. This might have been done by securing consistent trading partners, or by dispensing favors to those Indians deemed to be cooperative. The point of this discussion is to show that the traders were not passive players in a non-directed contact situation. Their active manipulation had consequences for cultural change, and by extension, for changes in the modified bone assemblages. This will be explored later in this section.

Social Consequences

Within the fur trade context described above, metal began to move into the Hidatsa villages. The social changes which followed can be inferred from other situations documented in the literature. When a new item of technology is introduced, prestige accrues to those who receive it. The new item can advance the prestige of those low in social standing if it is sufficiently superior to exisiting artifacts (Linton 1940:472-473). Metal was certainly such an item in the Knife River Hidatsa villages. It was clearly superior to bone or stone for equivalent tasks. Possession of metal could advance the social standing or prestige of someone who acquired it, either from another Indian group, or from Euro-American traders. The social consequences of this are considerable. Possession of metal would have allowed an individual to bypass bone tool crafts specialists, and avoid paying for laboriously manufactured bone tools. Bone tool specialists would have been idled as demand for their product lessened. The established social structure could be bypassed as well. People of low status, or those possessing little power, could use the new technology to move up or to acquire power outside of established channels. The established channels of authority and social heriarchy would have become more and more threatened as the early trickle of metal in the Indirect Trade period became a flood in the Direct Trade period.

The traders would certainly have taken advantage of such a situation to reward those Indians who had proven useful for their purposes. However, the traders might have been advancing the social standing of individuals who would never have achieved prominence or power under the native system. The qualities valued by the traders might not have been those valued by the Hidatsa. The classic paper describing such social disruptions is that of Lauriston Sharpe (1952), which describes the social consequences of the introduction of steel axes to the Yir Yoront Austrailian Aboriginals. The Yir Yoront are unusual in that one technological item was so crucial to the maintenance of social structure. A better example of the social disruptions brought by contact can be found among the 17th and 18th century Kickapoo in what is now Wisconsin (Silverberg 1957). In that case, social disruptions preceded the arrival of French traders. After their arrival, they took an active role in changing Kickapoo culture to further their own commercial interests. In a more extreme and controversial case, the eastern Algonkians may have hunted out all the fur bearing animals in their region after being decimated by Euro-American diseases (Martin 1978). When their medicinal procedures could not cure the diseases, they took to to be the result of betrayal of a long-standing relationship with the animals, and so hunted them out in retaliation. Not all of these processes occurred among the Hidatsa, but it is safe to say that social disruptions preceded the traders, and accelerated after their arrival.

Another factor to be considered in the fur trade sequence is the introduction of a market economy. The Hidatsa were certainly deeply involved in trade prior to contact, but the trade which followed contact was geared to serve distant Euro-American markets. Serving this market, through production of buffalo robes and other furs as well as garden produce changed much of the Hidatsa economy. Examination of the introduction of a market economy into other Indian groups suggests that in each case, economic dependence was the eventual result (White 1983). The Hidatsa were progressively drawn into a market economy, especially late in the occupation when river traffic from St. Louis became common. This factor will be considered in subsequent discussions of modified bone assemblage during the fur trade period.

Acculturation During The Fur Trade

This section will describe the effects of acculturation in the Hidatsa villages during the fur trade, taking into account the factors discussed above. The descriptions will be based upon the modified bone assemblage changes for each component described in detail in Tables 34-36 and in general terms in Tables 38 and 39.

Pre-Contact Scattered Village Complex (1400-1525)

This component is represented by a small sample, making concrete statements difficult. This is unfortunate, since it represents a clearly pre-contact context, and with a larger sample, would have provided valuable comparative material. However, some statements can be made regarding this period. Most major tool types are represented, none of the tools have been modified with metal, and no trade items are present.

From these assemblage characteristics, it can be determined that this component represents the pre-contact starting point for the changes to follow. At this time, a well developed native modified bone industry is present, exhibiting a wide variety of formal bone tools. The tools were laboriously manufactured by individuals with considerable skill in their craft. As was the case with other industries such as pottery, there were probably bone tool specialists, from whom tools, or the rights to make them, had to be purchased. At this time, the elaborate social and ceremonial system of the Hidatsa was still intact. The Hidatsa were well adapted to the severe climate of the northern Plains in their substantial villages, sustained by their gardens and the bison herds of the prairies. They had achieved at least security, if not prosperity. Some prosperity was achieved through regular trade contacts with distant tribes in other parts of the continent. However, they could not have imagined the changes which were set in motion during this period on a small island in the Caribbean. There, in 1492, Columbus made landfall, and the Old World began its reach toward the New.

Pre-Contact/Earliest Indirect Trade (1525-1600)

The sample in this component is also small, making interpretation difficult. Again, all major tool types are represented, and no trade materials are present. However, one bone tool during this period is modified with metal. It is a fragmentary scapula hoe, which exhibits faint cut marks that may have been made with a metal blade. It is difficult to draw sweeping generalizations from a single artifact, since the possiblility of metal in the villages prior to 1600 is theoretically possible but not probable. If the artifact is not intrusive, it likely belongs toward the end of the period.

This component exhibits many of the same characteristics described above for a pre-contact situation. However, if some metal found its way to the villages at this time, it would have passed through the hands of many other Indian groups. If present at all, metal would have been very scarce, and likely would have caused little social disruption of the type discussed above.

Early Indirect Trade (1600-1650)

During this component, the first metal artifacts are found, as well as three bone artifacts modified with metal. The sample is large enough to determine that awls form a very low percentage of the collection. The other major tool types are all represented.

During this period, the leading edge of the Indirect Trade Zone reached the Hidatsa villages. For the Indian people, it meant that unfamiliar metal objects became available from their regular trading partners in other tribes. The source of the metal was a series of small settlements along the eastern coast of North America, including one on the St. Lawrence River called Quebec, established in 1608. The low frequency of awls indicates that some replacement of formal bone tools was beginning to occur. Piercing tools were a prime candidate for replacement, since they could be replaced with very small items such as nails, commercial awls, or scraps of metal. Their small size facilitated transfer over great distances from one Indian group to another.

The social changes associated with this replacement became evident, even at this early date. Prestige surely accrued to those who had the metal awls, and social advancement may have followed outside of the usual channels. Those who made bone tools began to feel a decrease in demand for their products, and a change in their role within the community. All of this occured over a century before actual contact with Euro-Americans.

Middle Indirect Trade (1650-1700)

This component represents a continuation of the Indirect Trade period, in which trade goods were received from other Indian groups. In the modified bone assemblage, the first knife handles slotted for metal blades appear. They correspond to Quimby and Spoehr's (1951:124-125) category B-1, native types of artifacts modified by contact. They represent clear and convincing evidence of not only the presence, but also the use of metal. These artifacts represent not only changes in the modified bone industry, but in stone tools as well, since the metal blade replaces a chipped stone cutting element. There is a continued increase in metal modification of bone tools, and a sharp increase in trade items, both metal objects and glass beads. Awls continue in low frequencies, and an increase in expedient tools is noted.

Social changes continued during this period, increasing through time. The presence of knife handles slotted for metal blades represents the incorporation of metal into existing tool types. This implies social changes, in the form of acceptance of metal as a material superior to stone or bone. The replacement of chipped stone cutting elements probably had much the same social effect as the replacement of awls, which continued into this period. The increase in expedient tools suggests an increased importance for these simple artifacts. No manufacturing skill was required to make them, so they could be made and used by anyone. As will be seen in later periods, this may be related to the influx of metal, and the loss of formal bone tools such as awls and associated dependence upon traders.

Late Indirect Trade (1700-1750)

This period represents the last stages of Indirect Trade for the Hidatsa. La Vérendrye made contact with the Mandan at the Heart River in 1738, and some Canadian traders may have filtered into the area by 1750. For the most part, however, trade goods continued to come to the Hidatsa through their Indian trading partners in other tribes. The modified bone assemblage continues the trends established in the preceding period. Awls are low in number, an increase is noted in modification of bone tools with metal, and a sharp increase in both metal objects and glass beads is noted. Knife handles slotted for metal blades are present, and scapula tools exhibit an increase over the preceding period.

The social changes of the preceding period continue here. The low frequencies of awls and presence of knife handles slotted for metal imply continuing social disruption. More metal was present, accelerating the trends described earlier. During this period, the increase in scapula tools may indicate the beginnings of increased agriculture to meet trade demand. The Hidatsa were heavily involved in the aboriginal trade network prior to contact, and the presence of valuable Euro-American trade goods intensified their involvement. Their garden produce was a valuable commodity, and they may have been starting to exploit that advantage during this period. The continued increase of expedient tools suggests that they were assuming a more important role as metal increased. Thus, on the eve of regular contact with Canadian traders, the Hidatsa had been receiving trade goods, and enduring all their associated social changes, for over 150 years.

Early Middlemen Trade (1740-1790)

During this period, the Hidatsa moved into a lucrative role as middlemen in the fur trade. The modified bone assemblage continues many of the trends established earlier. Scapula tools and expedient tools continue to increase, as do metal artifacts and glass beads. Modification of bone tools with metal continues at levels similar to the preceding period.

During this period, Canadian traders established regular contact with the Hidatsa. Tenant traders also became common fixtures in the villages. Face to face contact with Euro-American traders was thus established, at least on an intermittent basis. However, the Hidatsa's main role was that of middlemen in the trade system. At this time, they found themselves between the advancing frontier of the horse from the southwest, and the gun from the northeast. They reaped considerable prosperity by passing such goods back and forth, always at a substantial markup. The increase in scapula tools may reflect this trade-related activity, as the Hidatsa increased their output of garden produce to meet trade demands. They were being steadily drawn into a market economy by this time, producing more garden produce, buffalo robes, and other furs to meet the needs of distant foreign markets. Some trends discussed earlier continued here as well. Awls continue to be low in frequency, and knife handles slotted for metal blades are present. The social disruptions already mentioned certainly continued here, although with more intensity, given the larger quantities of trade goods.

Disease became a major factor at this time, in the form of dislocations after the smallpox epidemic of 1780-81. This was apparently not the first epidemic, so the Hidatsa were beginning to pay a high price for their association with the fur trade.

Late Middlemen-Direct Trade (1790-1837)

During this period, the Hidatsa achieved their maximum level of involvement in the fur trade. They achieved considerable prosperity as middlemen early in the period. That began to change with the establishment of the water route from St. Louis and construction of short-lived trading posts near the Knife River. Their position was drastically undercut with the construction of Fort Clark in 1830, marking the beginning of the Direct Trade period.

The modified bone assemblage shows the culmination of several trends which had been present for some time. The maximum percentage of scapula hoes, knife handles slotted for metal blades, and expedient tools is reached. Sharp increases in metal modification of bone tools and frequencies of metal objects and glass beads can be documented. As in earlier periods, awls are present in low frequencies.

The large number of scapula tools is indicative of an effort to increase output from the gardens for use in trade. This suggests a high level of involvement in a market economy, a trend which began earlier. As was the case with other Indian groups, involvement in such an economy may have brought prosperity initially, but dependence upon the traders soon followed. A similar increase in hide processing tools is not seen, despite the obvious market value of hides. Garden produce was apparently the most important, marketable commodity at this time. Another factor in the persistence of scapula hoes might have been their size. Iron hoes to replace them were large, heavy, and difficult to transport to the area.

The high percentage of expedient tools indicates that this category had assumed considerable importance. This importance had gradually increased through the fur trade components. Expedient tools have been interpreted as butchering implements, and experimental studies have shown them to be effective for this purpose (Frison 1978:301-341). Therefore, the increase in expedient tools late in the fur trade could be related to increased butchering and hide preparation. Another possibility is that the increased number of expedient tools is related to increased dependence upon the traders. The large influx of metal at this time meant that many formal bone tools were being replaced. This developed dependence upon the traders, as the only source of the metal. As discussed earlier, such dependence would have worked to the traders' advantage. Expedient tools thus gained importance as dependence increased and the knowledge of manufacturing formal bone tools was lost. They could be used by anyone, with no knowledge of difficult manufacture techniques.

After the Lewis and Clark expedition of 1804-06, the trade pattern changed from one dominated by overland contact with Canada to one dominated by river traffic from St. Louis. Trade goods began to arrive by the ton, first in keel boats and later in steam boats. The social disruptions mentioned earlier probably reached a peak at this time, as the Hidatsa villages were flooded with all types of trade goods. Many of the old social structures surely disappeared at this time. The smallpox epidemic of 1837 effectively ended the occupation in the Knife River area, though the remnants of the river tribes held on for a few more years.

Direct Trade (1830-1845)

This component is represented by a very small sample from one excavation unit at the Big Hidatsa site. The sample is too small to make any statements regarding assemblage structure. This is unfortunate, since this is the time during which remnants of all three river tribes lived at Big Hidatsa prior to their departure for Like-A-Fishhook village.

Concluding Statement

The value of research into modified bone assemblages has been established in this study. However, such studies can only be productive in well documented situations. The interpretations made here depend upon good chronolological and stratigraphic control, along with consistent recovery procedures. Excellent historic documentation has also been critical to this analysis.

The limitations of modified bone studies are numerous. In the Middle Missouri, it is not possible to do the same sort of fine-grained chronological analysis with bone tools as is possible with pottery. Modified bone technology exhibits too much stability for many chronological comparisons. The only exception is the period of Euro-American contact, where there is sufficient change in a short period of time for modified bone analysis to be productive. The changes in modified bone technology through the fur trade as derived in this study may have some benefit in other contact situations. In any case, modified bone research is a viable and exciting field of study which can provide meaningful information for anthropological interpretations.

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